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Pro-Environmental Attitudes and Behaviours: The Role of Individual Differences

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Declaration

I hereby declare:

a) that this dissertation was of my own composition, and

b) that it contained no material previously submitted for the award of any other degree, and

c) that the work reported in this dissertation was executed by myself except where due acknowledgment was made in the text, and

d) that the included publications were my own work.

Signed,

Alistair Raymond Bryce Soutter

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Altyd in ons harte

A Note on Personal Pronouns

This dissertation was based to a large extent on published work. In order to maintain consistency with these pieces of work, and in acknowledgement of the collaborative nature of this work with my supervisors René Mõttus and Tim Bates, the collective term of “we” rather than “I” will be used throughout this dissertation.

Abstract

The work within this dissertation primarily focused on what types of people do (not) care or act pro-environmentally and examined potential mechanisms for promoting pro-environmental attitudes and behaviours. Chapter 1 provided an initial introduction to this topic and the disciplines of environmental and conservation psychology. It presented the history of research, the current state of research, and the contribution of individual differences on understanding pro-environmental attitudes and behaviours.

The first part of this dissertation concerned itself with the measurement of pro-environmental attitudes and behaviours. In Chapter 2, the factor structure of two new pro-environmental attitudes and behaviours measures were assessed, which resulted in two unidimensional measures. These two measures were found to be associated with an existing measure of pro-environmental behaviours, demonstrating their predictive and concurrent validity respectively. In Chapter 3, the test-retest reliability, internal consistency, predictive validity for pro-environmental behaviours, and concurrent validity of the newly created pro-environmental attitudes measure were assessed. Furthermore, the concurrent validity of the newly created pro-environmental behaviours measure was further assessed. These new measures demonstrated acceptable concurrent validity. Furthermore, the new measure of pro-environmental attitudes demonstrated acceptable to good test-retest reliability, internal consistency, and predictive validity for pro-environmental behaviours on par with existing measures of pro-environmental attitudes. Lastly, this chapter identified several existing measures of pro-environmental attitudes that had acceptable to good test-retest reliability, internal consistency, and predictive validity for pro-environmental behaviours. This formed the basis of measurement for future chapters.

The second part of this dissertation concerned itself with how personality was associated with pro-environmental attitudes and behaviours, and how this could be used to inform effective interventions. In Chapter 4, a meta-analysis was conducted that assessed how the personality domains of the Big Five and HEXACO were associated with pro-environmental attitudes and behaviours. The meta-analysis of 38 sources, implicated Openness and Honesty-Humility as the strongest correlates of pro-environmental attitudes and behaviours. Agreeableness, Conscientiousness, and to a lesser extent Extraversion were also associated with pro-environmental attitudes and behaviours. Neuroticism was not associated with pro-environmental attitudes and behaviours. Furthermore, the meta-analytic associations, collectively, provided substantial predictive accuracy for pro-environmental attitudes and behaviours. Chapter 5 expanded on this and examined how personality at a facet-level, rather than domain-level, was associated with pro-environmental attitudes and behaviours. Using two datasets (N = 501 and 287) certain facets were identified as the main drivers of domain-level associations. Furthermore, these facet-level associations accurately predicted pro-environmental attitudes and behaviours, on par with domain-level associations.

The third part of this dissertation concerned itself with how political preferences were associated with pro-environmental attitudes and behaviours, and how this could be used to inform effective interventions. In Chapter 6, a replication of a study conducted by Schuldt, Konrath, and Schwarz (2011) was conducted. This replication assessed whether there was an interaction between question wording and political preferences on pro-environmental beliefs. In this pre-registered large cross-country study (United States of America, United Kingdom, and Australia; N = 5,717), it was found that the previously reported interaction between question wording and political preferences no longer existed. However, it was consistently found that Conservatives were less likely to believe in climate change/global warming when compared to Liberals. Chapter 7 expanded on this and examined various operationalisations

of political preferences, the potential confound of personality, and how political preferences might be associated with a range of pro-environmental attitudes and behaviours. This study (N = 499) replicated the finding that Conservatives were less likely to believe in climate change/global warming than Liberals, regardless of how political preferences were operationalised. The interaction between political preferences and question wording on pro-environmental beliefs occurred when political preferences were operationalised as continuously measured political orientation, but in the opposite direction to Schuldt and colleagues (2011). Furthermore, this interaction did not exist when political preferences were operationalised as party voted for. Personality traits did not confound these effects. Furthermore, political orientation was associated with pro-environmental attitudes and behaviours, when controlling for personality traits. The personality domains of Openness, Conscientiousness, and Agreeableness were associated with pro-environmental attitudes and behaviours when controlling for political preferences (regardless of operationalisation). However, political preferences were no longer associated with pro-environmental behaviours, and Agreeableness was inconsistently associated with these behaviours, when the demographic variables of age, gender, area, income, and education were also controlled for.

Lastly, in Chapter 8 a summary of the previous chapters' results and their contextualisation in the wider literature was presented. Furthermore, the future directions of research on pro-environmental attitudes and behaviours, and in particular, the role of individual differences in this research was explored.

Lay Summary

This dissertation examined what types of individuals do (not) care or act pro-environmentally and examined potential mechanisms for promoting pro-environmental attitudes and behaviours. This dissertation was broken into three parts. In Part 1 new measures of pro-environmental attitudes and behaviours were created. Their psychometric properties were assessed alongside existing measures of pro-environmental attitudes and behaviours. Furthermore, the psychometric properties of existing measures of pro-environmental attitudes were assessed. In Part 2 the associations between personality traits and pro-environmental attitudes and behaviours were examined. Openness and Honesty-Humility had the strongest associations with pro-environmental attitudes and behaviours. Agreeableness, Conscientiousness, and Extraversion were also associated with these attitudes and behaviours, but to a lesser extent. Neuroticism had no association with these attitudes and behaviours. Collectively these personality traits accurately predicted pro-environmental attitudes and behaviours. Examining personality traits at a narrower level provided greater knowledge on what aspects of these personality traits were the drivers of these associations. However, this greater knowledge provided no additional ability to predict pro-environmental attitudes and behaviours. In Part 3 a replication of a previous finding, that Conservatives were less likely to believe in global warming than in climate change, was conducted. This finding was not replicated, with Conservatives believing equally in these two phenomena. Political preferences' associations with pro-environmental attitudes and behaviours were further examined. It was found that Conservatives believed less in environmental phenomena and were less likely to hold pro-environmental attitudes and behaviours than Liberals. Overall, it was demonstrated that personality and political preferences facilitated an understanding of why individuals do (not) care or act pro-environmentally.

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Chapter 1: An Introduction

1.1 Humans and the Natural Environment

An overwhelming majority of scientists agree that climate change will lead to drastic changes in Earth's ecosystems (e.g. Intergovernmental Panel on Climate Change, 2018; Klein, Hilbig, & Heck, 2017; United Nations Environment Programme, 2019). For example, some have argued that a sixth mass extinction is currently underway, with 15 to 37% of species expected to be extinct by 2050 (Baronsky et al., 2011; Ceballos et al., 2015; Wake & Vredenburg, 2008). In addition, climate change models have predicted that at the current rate there will be a 0.7 to 1.2m sea level rise by the end of the 21st century (Horton, Rahmstorf, Engelhart, & Kemp, 2014), with the loss of mountain glaciers and polar ice sheets contributing about 1.85mm to this rise per year (Bamber, Westaway, Marzeion, & Wouters, 2018). Furthermore, climate change is predicted to increase extreme weather events (Durack, Wijffels, & Matear, 2012; Hansen, Sato, & Ruedy, 2012), such as heat waves (Luber & McGeehin, 2008), which could have severe consequences for people (e.g. 14,947 deaths in 12 days due to a 2003 heat wave in France; Poumadère, Mays, Le Mer, & Blong, 2005). There is a wealth of evidence that humanity had, continues to have, and is likely to have dramatic impacts on the natural environment.

Even as far back as ancient Greece, humanity's impact on the natural environment was known, as indicated by a quote from Theophrastus (a student of Aristotle):

> Then the water were plentiful and the whole area was like a swamp. However, after the water have been drained and steps taken to prevent a renewal of their stagnation, the region became colder and freezing occurs more frequently…Olive trees, that were once around the city large and beautiful, do not exist any more, and the wine which was never affected by the cold before, now is frequently harmed. (Neumann, 1985, pp.447)

It is clear that the ability of humans to impact the natural environment is not a new discovery. Consistent with a wealth of scientific evidence, it is a shared belief among many scientists that climate change is one of the greatest threats of our time (Hilbig, Zettler, Moshagen, & Heydasch, 2013; Intergovernmental Panel on Climate Change, 2018; Klein et al., 2017; Nisbet, Zelenski, & Murphy, 2009; Otto, Kaiser, & Arnold, 2014; United Nations Environment Programme, 2019).

Although the science may be fairly settled on the fact that humans had and continue to have an impact on the natural environment, what is less clear is an understanding of the psychological processes that drive humans (un)environmental attitudes and behaviours. Despite the obvious connection between humans and the natural environment, the scientific study of this connection is relatively recent. It was this topic, understanding humans' psychological connection with the natural environment, and the questions this prompted, that this dissertation was concerned with and aimed to provide some answers to.

1.2 The Origins of Biophilia and Psychology

Biophilia can be defined as a love of life and the living world, originally coined by Erich Fromm (1964), it was popularised by Edward Wilson who proposed the biophilia hypothesis (Wilson, 1984). The biophilia hypothesis suggested that humans have a natural desire to connect with nature and other forms of life (Kellert & Wilson, 1993). Maloney and Ward (1973) argued that humanity's growing awareness of its destructive impact on the natural environment, had led humanity to seek solutions for this, especially in the realm of technological solutions. However, there are problems with looking for technological solutions, as Maloney and Ward put it quite simply:

> Furthermore, technological solutions have a certain intrinsic futility since the present issue is best conceptualized as a problem of increasing population, increasing

> consumption, and increasing demand. Conceptualized in this manner, the solution to such a problem does not lie in traditional technological approaches but rather in the alteration of human behavior. In short, the ecological crisis is a crisis of maladaptive behavior. (Maloney & Ward, 1973, pp. 583)

Maloney and Ward (1973) criticised the recently emerged discipline of environmental psychology as being too traditional and focusing too much on how the environment (natural and built) impacted humans' behaviours, while ignoring the impacts humans' behaviours had on the natural environment. To address this, they developed one of the first measures of pro-environmental attitudes and behaviours, the Ecology Scale. This development facilitated further research in environmental psychology, particularly in understanding why/how humans interact with the natural environment. But what is environmental psychology?

1.2.1 Environmental Psychology

Environmental psychology emerged in the late 1960s and early 1970s (Stokols, 1978), as a multidisciplinary discipline involving psychologists, geographers, political scientists, anthropologists, and architects to name but a few (Craik, 1973). In the first annual review of environmental psychology, it was defined as the study of man-environment relations (Craik, 1973). This description was further refined to define environmental psychology as bringing together and assessing the interactions of humans with aspects of the socio-physical surroundings (Canter & Craik, 1981). In more modern literature, the Journal of Environmental Psychology, one of leading journals in this discipline, describes the research it publishes as examining transactions and interrelationships between people and their surroundings (whether built, social, natural, or virtual) and the use and abuse of nature and natural resources (Elsevier, 2020).

Environmental psychology, as result of its broad definition, has incorporated a diverse range of research. For example, early annual reviews of the discipline highlighted research on privacy, overcrowding, how light or smells can impact behaviours, how people navigate built environments, people's views of the natural environment, and their behaviours within the natural environment (e.g. Craik, 1973; Russell & Ward, 1982; Stokols, 1978). This diversity of research has continued in modern research, with the Journal of Environmental Psychology publishing research that covers, social use of space (e.g. crowding and privacy), place attachment, cognitive mapping, environmental risks and hazards, and theories of pro-environmental attitudes and behaviours (Elsevier, 2020). Environment and Behavior (another prominent journal in the discipline) publishes research on topics such as nature and psychological restorativeness, effects of ambient conditions, effects of innovative designs, and pro-environmental behaviours and behaviour change (SAGE, 2020).

Craik in the earliest review of environmental psychology described it as a "broad, thin, but rapidly expanding layer of empirical research" (1973, pp.412). Although the expansion of research might have made environmental psychology less of a "thin" layer it is still quite broad. Furthermore, environmental psychology has focused on the built environment and how the environment (natural and built) affects human behaviours, rather than the natural environment specifically and how human behaviours affect the natural environment (Kidner, 1994; Saunders, 2003). Due to this, an even newer discipline of psychology emerged, termed conservation psychology. What then is the difference between environmental psychology and conservation psychology?

1.2.2 Conservation Psychology

Conservation psychology, formalised in 2003, examines the reciprocal relationships between humans and the natural environment, with a particular focus on improving environmental conservation (Saunders, 2003). The dual aims of conservation psychology are

a) to understand why people do (not) act pro-environmentally and b) to understand how to promote pro-environmental behaviours and reduce un-environmental ones (Clayton & Brook, 2005). Conservation psychology is a mission driven applied discipline, that incorporates multiple disciplines of study (Saunders, 2003). Thus, it is similar to environmental psychology in that it focuses on human-environment relationships. However, unlike environmental psychology, conservation psychology exclusively focuses on the natural environment (Clayton & Brook, 2005).

Although these are separate disciplines, there is a broad overlap between the two, in that they both examine humans' relationships with the natural environment. Furthermore, due to the recency of conservation psychology and its roots in environmental psychology, these two disciplines share measures, research interests, and often publish in similar, if not the same journals. For these reasons, and to avoid being bogged down in the definitions of these two disciplines, in this dissertation we will discuss these two disciplines in tandem throughout.

While both these disciplines utilise psychological knowledge to understand environmental issues, the role of psychology in dealing with environmental issues is underutilised (Clayton & Brook, 2005; Saunders, 2003). This was reflected in views from environmental professionals. A survey of 1,300 alumni of environmental programmes rated the need for psychological understanding in their discipline as lower than sociology, political science, philosophy, and public health (Scott, 2004). Furthermore, surveys of the American Psychological Association's divisions (Clayton & Brook, 2005) and psychology students (Clayton, 1999) reflected similar beliefs that environmental issues were not important issues for psychology. However, psychology is important in solving environmental issues.

The importance of psychology in solving environmental issues can be conceptualised in two primary ways. Firstly, we are uniquely positioned, as perhaps the only species capable of not only understanding environmental issues but also the implementation of programmes, policies, interventions, behaviours, and technologies to solve said issues. Thus, as we are the only species capable of doing so, it is vitally important to understand why humans do (not) enact these solutions. Secondly, with widespread acceptance and understanding that many environmental issues (e.g. climate change) are anthropogenic in nature, it is vital to understand why humans contribute to these environmental issues. Thus, despite the assertations by some that psychology had no role in dealing with environmental issues, psychology is vitally positioned to be able to contribute not only to understanding these environmental issues, but in the implementation of successful solutions (Clayton & Brook, 2005; Saunders, 2003). However, for psychology to do this, effective tools are required in order to measure and assess pro-environmental attitudes and behaviours.

1.3 Measurement of Pro-Environmental Attitudes and Behaviours

Pro-environmental attitudes can be broadly defined as one's tendency to exhibit favour towards the natural environment (Hawcroft & Milfont, 2010; Milfont, 2007). Pro-environmental behaviours can be defined as concrete actions (including not taking an action), whether deliberate or not, that positively impacts the natural environment. This dissertation will now present a brief overview of the history of the measures used to assess these pro-environmental attitudes and behaviours. In Chapter 2 and 3 a more detailed analysis of some of the more widely used measures of pro-environmental attitudes and behaviours was provided.

1.3.1 Pro-Environmental Attitudes

The first explicit measures of pro-environmental attitudes were developed in the 1970s (Clayton, 2012), with three major measures being developed during this time. Firstly,

the aforementioned Ecology Scale was developed in 1973 which assessed verbal commitment, actual commitment, affect, and knowledge (Maloney & Ward, 1973), and was later reduced in length (Maloney, Ward, & Braucht, 1975). Secondly the Environmental Concern Scale (ECS), was designed to overcome the shortcomings of the Ecology Scale, which used a single sample for reliability, and only known group comparisons for validity (Weigel & Weigel, 1978). Thirdly, the New Environmental/Ecological Paradigm (NEP) was developed in an effort to measure newer and broader issues such as the limits to growth, steady-state economy, etc. (Dunlap & Van Liere, 1978), and was later revised and updated (Dunlap, Van Liere, Mertig, & Jones, 2000). Since these early measures, several pro-environmental attitudes measures were created, such as, the Environmentalism Scale (Banerjee & McKeage, 1994), Animal Attitudes Scale (Herzog Jr, Betchart, & Pittman, 1991), Kellert's typologies (e.g. Kellert, 1984, 1985), and a pro-environmental concern measure (Schahn & Holzer, 1990) to name but a few. Despite the multitude of measures developed, the original three measures, the Ecology Scale, ECS, and the NEP are amongst the most commonly validated and used measures of pro-environmental attitudes (Fransson & Gärling, 1999; Milfont & Duckitt, 2010).

The beginning of the 21st century saw a further expansion of the diversity of pro-environmental attitudes measures. One measure of note is the Environmental Attitudes Inventory (EAI), which was developed to assess a multidimensional and hierarchical model of pro-environmental attitudes (Milfont & Duckitt, 2010). Another important avenue of assessing pro-environmental attitudes, is exploring the connection humans feel towards the natural environment (Frantz & Mayer, 2014). These aspects of pro-environmental attitudes were defined as the feelings individuals have of being connected or belonging to the broader natural environment (Mayer & Frantz, 2004). Several measures were designed to tap into these aspects of pro-environmental attitudes (Martin & Cezllar, 2016), including the

Inclusion of Nature in Self measure (Schultz, 2001), Environmental Identity (Clayton, 2003), Nature Relatedness (Nisbet et al., 2009), and the Connectedness to Nature Scale (CNS; Mayer & Frantz, 2004) to name but a few.

Although this was a brief overview it is clear that there is now an extensive base of tools in which to measure individuals' pro-environmental attitudes (Dunlap & Jones, 2002; Milfont & Duckitt, 2010). Some have stated that there are now too many pro-environmental attitudes measures, which has resulted in an "anarchy of measurement" (Stern, 1992, pp. 279). The elusiveness of a gold-standard measure to assess pro-environmental attitudes, poses a fundamental problem for researchers, particularly those who are new to the discipline. This problem is knowing what the best measure to use is. Although some attempts to assess multiple measures of pro-environmental attitudes had been made (e.g. Tam, 2013a), there had been little attempt to systematically assess multiple measures of pro-environmental attitudes together. This formed a motivation for Chapter 2 and 3 of this dissertation, in which we aimed to a) create a measure that addressed the shortcomings of established pro-environmental attitudes measures and b) assess the psychometric properties of several existing measures of pro-environmental attitudes. Doing so would form the basis for the measures we would use in future research.

1.3.2 Pro-Environmental Behaviours

Although the measurement of pro-environmental attitudes is difficult, the measurement of pro-environmental behaviours is perhaps even more complex. Not only is there a lack of a gold-standard measure of pro-environmental behaviours, but there is also a lack of widely used general measures of pro-environmental behaviours. Despite research beginning in the late 1960s and early 1970s, there is no consistently used measure of pro-environmental behaviours (Markle, 2013). This was exemplified by a review of 49 articles, of which 42 used a unique measure of pro-environmental behaviours (Markle, 2013). Although

it is difficult to pinpoint the first measure of pro-environmental behaviours, the first general measure developed was perhaps the actual commitment component of the Ecology Scale (Maloney & Ward, 1973). Only two other general measures of pro-environmental behaviours were developed before the end of the 1990s, these being the Behaviour Inventory of Environmental Action (Sia, Hungerford, & Tomera, 1986) and another developed by Fejer and Stroschein (Kaiser, 1998). However, several problems were identified with these existing measures, and none are widely used anymore (Kaiser, 1998). Proposing a solution to this the General Ecological Behavior (GEB) measure was created (Kaiser, 1998).

The GEB was designed using a probabilistic measurement approach (Kaiser, 1998). This method allowed people to behave less than totally consistent across several behaviour domains, without creating a multidimensional measure. Furthermore, it allowed the difficulty of performing a behaviour to be accounted for. This was done by applying a Rasch scale (which is probabilistic) instead of a Guttman scale (which is deterministic). The Rasch scale, scales individual's responses by their performance on other items and the difficulty of the item (assessed by how many other respondents said they performed the behaviour). This measure originally consisted of 30 behavioural items, answered on a true/false response format, and was found to be cross-culturally applicable (Kaiser & Biel, 2000). This measure was later expanded to include an additional 13 items (Kaiser & Wilson, 2000). However, some of the items within this measure were criticised as having little environmental impact (Markle, 2013).

Another general measure of pro-environmental behaviours that had been developed was the Stanford Climate Change Behavior Survey (Armel, Yan, Todd, & Robinson, 2011). This 97-item measure assessed behaviours that contributed to greenhouse gas emissions, which covered categories of electricity, transportation, waste, and food (Armel et al., 2011). However, this measure was not widely adopted in the literature. Furthermore, it had been

criticised for its length and exclusive focus on private-sphere environmentalism (Menardo, Brondino, & Pasini, 2019). One measure that addressed the criticisms of this measure and the GEB was the Pro-Environmental Behavior Scale (PEBS; Markle, 2013; Menardo et al., 2019).

The PEBS was developed in order to address the lack of a consistent measure of pro-environmental behaviours (Markle, 2013). Furthermore, it was developed to create an empirically derived, comprehensive measure that assessed only environmentally impactful behaviours, in a concise form. This measure originally consisted of 38 items, which assessed consumer activities that contributed to the most pressing environmental problems of air pollution, global warming, habitat alteration, and water pollution (Brower & Leon, 1999; Markle, 2013). Three areas (food, transport, and household operations), and a fourth set of activities (focused on environmental citizenship) were created to form the PEBS. A final 19-item measure, which assessed the four areas of food, transport, citizenship, and conservation (household operations) was created (Markle, 2013).

Although some measures may have been missed, this section provided a brief overview of the history of the most prominent measures of general pro-environmental behaviours. Although some had argued that a general measure of pro-environmental behaviours was not useful (e.g. Midden & Ritsema, 1983), the inconsistency in pro-environmental behaviours measures across studies has made it difficult to assess and compare studies with disparate measures (Kaiser, 1998; Levine & Strube, 2012; Markle, 2013; Walton & Austin, 2011). Thus, it was clear that a general pro-environmental behaviours measure was needed if researchers wished to compare studies. This provided a further motivation for the work conducted in Chapter 2 and 3 of this dissertation, in which we aimed to a) create a general measure of pro-environmental behaviours and b) assess the psychometric properties of this new measure against existing measures of pro-environmental behaviours.

Despite the issues with the existing base of measures, a progressive examination of humanity's association with the natural environment and an understanding of why individuals do (not) care or act in pro-environmental ways had occurred. This dissertation will now briefly discuss the contributions various disciplines within psychology have made to environmental and conservation psychology in understanding pro-environmental attitudes and behaviours.

1.4 Psychology and Pro-Environmental Attitudes and Behaviours

Despite the relative recency of psychology's contribution to the study of pro-environmental attitudes and behaviours, there has been a growing body of research in this area. Due to the multidisciplinary nature of environmental and conservation psychology, the research contributing to these disciplines constitutes many diverse lines of research. While an examination of all these lines of research was beyond the scope of this dissertation, a brief overview of two seminal meta-analyses will be discussed, followed by some of the diverse lines of research within environmental and conservation psychology.

Two seminal meta-analyses examined how several factors impacted pro-environmental behaviours. The first meta-analysis analysed research from the first decade of environmental psychology (1971 to 1987), with the aim of finding those variables most strongly associated with pro-environmental behaviours (Hines, Hungerford, & Tomera, 1987). An analysis of 128 studies revealed four major categories of variables associated with pro-environmental behaviours: 1) cognitive variables, 2) psycho-social variables, 3) demographic variables, and 4) experimental interventions. These categories were then broken down and meta-analysed independently. Cognitive variables were defined as knowledge of the natural environment or environmental issues, which had a meta-analytic association of r = .30 with pro-environmental behaviours. Psycho-social variables were defined as individual personality characteristics, including how others saw themselves and others. This was split

into pro-environmental attitudes (r = .35), locus of control (r = .37), economic orientation (r = .16), personal responsibility (r = .33), and verbal commitment (r = .49), which were moderately to strongly associated with pro-environmental behaviours. The demographic variables assessed were weakly to moderately associated with pro-environmental behaviours: gender (r = .08), age (r = -.15), income (r = .16), and education (r = .19). Lastly, within experimental interventions it was found that appeals had the strongest influence on pro-environmental behaviours (r = .71), followed by incentives (r = .69), information (r = .47), and feedback (r = .28). Consequently, Hines and colleagues proposed a model of pro-environmental behaviours in which personality factors (which pro-environmental attitudes, locus of control, and personal responsibility contributed to), knowledge (of issues and action strategies), and action skills would jointly influence an individual's intention to act. This intention to act alongside situational factors would then lead to pro-environmental behaviours.

Twenty years later this seminal piece of work was replicated (Bamberg & Möser, 2007). The replication aimed to a) update the meta-analysis and b) meta-analytically test the model of pro-environmental behaviours proposed by Hines and colleagues (1987). Assessing research (1995 to 2006) that primarily focused on either the Norm-Activation Model or the Theory of Planned Behaviour, 46 studies were identified and utilised. Unlike the original meta-analysis, the demographic variables of gender, age, income, and education were not assessed, neither was the psycho-social variable of economic orientation. The cognitive variable of knowledge was re-defined as problem awareness and had a weaker association than before (r = .19). However, the remaining variables of pro-environmental attitudes (r = .42), perceived behavioural control (r = .30; re-naming of locus of control), moral norm (r = .39; re-naming of personal responsibility), and intention (r = .52; re-naming of verbal commitment) were of similar strengths to the previous meta-analysis. New potential

associates were assessed and found to be associated with pro-environmental behaviours, these being social norms (r = .31), feelings of guilt (r = .30), and internal attribution (r = .24). Lastly, the model of pro-environmental behaviours proposed by Hines and colleagues and these additional variables examined, were assessed via meta-analytic structural equation modelling. The results of which confirmed that intention to act pro-environmentally mediated the impact that psycho-social variables had on pro-environmental behaviours. Furthermore, the results demonstrated that moral norms alongside perceived behavioural control and pro-environmental attitudes impacted one's intention to act.

Apart from these seminal meta-analyses there has been a considerable body of research in areas that were (not) assessed by these meta-analyses. Various disciplines of psychology have contributed to the research conducted within environmental and conservation psychology. The contribution of some of these disciplines, will now be briefly presented.

Developmental psychology has examined how pro-environmental attitudes and behaviours are shaped by the socio-cultural context individuals were born and raised in. For example, attitudes that were formed early in life tended to be persistent throughout later periods of life (Bjerke, Ødegårdstuen, & Kaltenborn, 1998). But what socio-cultural contexts during development help shape these attitudes? One possibility is early childhood experiences with nature. Indeed, environmental activists tended to recall positive experiences with nature in their childhood and stated that this helped shape their connection with nature (Chawla, 1999; Horwitz, 1996). This idea was supported empirically, in that early experiences of nature were positively associated with later life pro-environmental attitudes and behaviours (Wells & Lekies, 2006). Furthermore, environmental activists, compared to non-activists, reported greater positive experiences with nature early in life (Bisson, Alisat, Norris, & Pratt, 2012). However, negative experiences, such as the destruction of the natural

environment, were also found to be pivotal in forming a connection to the natural environment (Bisson et al., 2012). Studies with children had examined how contact with nature shaped pro-environmental attitudes and behaviours. For example, amongst Chinese children (9 to 10 year olds) it was found that greater contact with nature was associated with stronger biophilic attitudes and weaker biophobic attitudes. Furthermore, contact with nature had an indirect association with general conservation attitudes and willingness to conserve animals through biophilic attitudes (Zhang, Goodale, & Chen, 2014).

Evolutionary psychology has also examined how development, but in an evolutionary sense, can help explain and understand individuals' pro-environmental attitudes and behaviours. Perhaps some of the earliest work in this area was not conducted by psychologists, but instead by biologists, beginning with the aforementioned biophilia hypothesis (Kellert & Wilson, 1993; Wilson, 1984). This theory suggested that humans developed an innate tendency to affiliate with nature. This innate tendency was attributed to our evolutionary development within the natural environment (Kellert & Wilson, 1993). Research had suggested that there is some evidence for this innate affinity towards nature. For example, photographs of nature scenes were rated more favourably than urban spaces (A. Purcell, Lamb, Mainardi Peron, & Falchero, 1994; T. Purcell, Peron, & Berto, 2001; Stamps III, 1996; van den Berg, Koole, & van der Wulp, 2003). Furthermore, behavioural indicators provided further evidence for this innate affinity. For example, people visit zoos more often than sporting events (Wilson, 2006), pay higher prices for real estate in natural surroundings (Luttik, 2000), and those in urban environments decorate their spaces with nature (Kaplan & Kaplan, 1989). Lastly, the innate affinity for nature can be seen in innate fears of those environmental aspects that would pose humans harm, for example snakes and spiders (Öhman & Mineka, 2001). Subsequently if humans evolved a natural affinity towards nature, associating with nature should provide benefits for humans.

The benefits of the natural environment for human well-being have been well demonstrated. For example, exposure to nature increased recovery after surgery (Ulrich, 1984), and living in rural, compared to urban, areas was associated with less of an amygdale response during stressful tasks (Lederbogen et al., 2011). Furthermore, a recent meta-analysis found that exposure to the natural environment was associated with a moderate increase in positive affect and a decrease, albeit smaller, in negative affect (McMahan & Estes, 2015).

Lastly, evolutionary psychology had suggested that using this natural affinity, by priming people with natural environments, should promote pro-environmental attitudes and behaviours. Past research demonstrated that exposure to nature videos, resulted in more pro-environmental and cooperative behaviours (Zelenski, Dopko, & Capaldi, 2015) and that visiting zoos increased an implicit, but not explicit, connection with nature (Bruni, Fraser, & Schultz, 2008). However, other research suggested that there might be some limitations to the impact of these exposures. For example, exposure to nature documentaries had no impact on connection to nature, and only increased pro-environmental behaviours in those with an initially strong connection to nature (Arendt & Matthes, 2016).

Social psychology has been used to examine how environments (natural and built) shape pro-environmental attitudes and behaviours. Researchers who focus on pro-social motivations for behaviours tend to use the Norm-Activation Model (Schwartz, 1977) as a theoretical framework. This framework emphasises that moral or personal norms are direct determinants of pro-social behaviours, such as environmentalism. Those who focus on self-interest motivations for behaviours instead prefer rational choice models such as the Theory of Planned Behaviour (Ajzen, 1991; Bamberg & Möser, 2007). The Theory of Planned Behaviour proposes that attitudes, subjective norms, and perceived behavioural control impact behavioural intentions and subsequently actual behaviours (Ajzen, 2002). Regardless of the model used, or motivational focus assessed, both frameworks highlight the importance

of norms, which had been found to be associated with pro-environmental attitudes and behaviours. For example, subjective norms, what we think others will think of us if we do (not) act, were positively associated with pro-environmental behaviours (e.g. Chen, Lupi, He, & Liu, 2009; De Groot & Steg, 2009; Marshall, Cordano, & Silverman, 2005; Zubair & Garforth, 2006).

It is evident that there has been a wealth of research from various disciplines within psychology that have contributed to our accumulated understanding of pro-environmental attitudes and behaviours. However, as an individual's impact on the natural environment involves a variety of behaviours enacted across a wide range of situations and repeated over extended periods of time it is crucial to understand what shapes these persistent attitudes and behaviours (Markowitz, Goldberg, Ashton, & Lee, 2012). This patterning of behaviour is what individual differences research examines. It is the contribution that individual differences research could have on understanding pro-environmental attitudes and behaviours that this dissertation was primarily concerned with.

1.5 Personality and Pro-Environmental Attitudes and Behaviours

Personality, an area of individual differences, consists of personality traits, and can be defined as characteristic patterns of thoughts, feelings, and behaviours (American Psychological Association, 2020), and forms a core part of one's motivations, beliefs, values, and attitudes. It is therefore likely to be a powerful and ubiquitous antecedent for differences in individuals' pro-environmental attitudes and behaviours (Karbalaei, Abdollahi, Momtaz, & Talib, 2014).

1.5.1 Early Research on Personality Traits

The idea that personality traits could contribute to environmental psychology (and later conservation psychology) is not new (Craik, 1973). One of the earliest assessments of an

environmental personality was the Environmental Response Inventory. The Environmental Response Inventory was designed to measure environmental dispositions that were personologically meaningful and possessed predictive utility in understanding environmentally associated behaviours (McKechnie, 1970). Similar measures such as the Wildernism scale (Hendee, Catton, Marlow, & Brockman, 1968) and several measures of the stimulus-seeking disposition (Howard, 1961; Penny & Reinehr, 1966; Zuckerman, Kolin, Price, & Zoob, 1964) were also used to assess personality's association with environmentally associated behaviours. However, although these measures assessed environmentally associated behaviours, they were not necessarily relevant to pro-environmental behaviours or wider environmentalism *per say*. For example, skiing is an environmentally associated behaviour, but not necessarily a pro-environmental one.

More contemporary research focused on how personality traits were associated specifically with pro-environmental attitudes and behaviours. Personality traits were identified as key factors in the meta-analyses of Hines and colleagues (1987) and Bamberg and Möser (2007). As discussed in section 1.4 these personality traits included locus of control/perceived behavioural control, personal responsibility/moral norms, verbal commitment/intention, and economic orientation. Research on other personality traits, found that femininity was positively associated with pro-environmental attitudes, while masculinity was negatively associated with it (Zelezny, Chua, & Aldrich, 2000), and that the intergroup anti-egalitarianism aspect of social dominance orientation was negatively associated with pro-environmental attitudes and behaviours (Stanley, Wilson, Sibley, & Milfont, 2017). Historically much of the research on personality traits' associations with pro-environmental attitudes and behaviours focused on these narrowly constructed traits (Markowitz et al., 2012; Milfont & Sibley, 2012). However, personality research concerning broader personality traits,

such as the domains of the Five-Factor Model (McCrae & John, 1992) or the Big Five (Goldberg, 1990), and the HEXACO (Ashton & Lee, 2007) is becoming more prominent.

1.5.2 Broad Trait Assessment

The study of these broader constructs of personality was suggested to be useful for three key reasons (Markowitz et al., 2012). Firstly, it was suggested that these broader domain constructs represent the more basic stable individual differences that could be used to predict patterns of behaviours (Funder, 1997). As pro-environmental individuals are conceptualised as this (i.e. acting pro-environmentally across time, situations, and behaviours), it makes sense to study these broad constructs. Secondly, if pro-environmental attitudes and behaviours were at least partially derived from stable individual differences, one should expect these broad domain constructs to be able to partially explain differences between individuals' pro-environmental attitudes and behaviours. Thirdly, the examination of these highly stable constructs may provide a more reliable understanding of why individuals do (not) act or think pro-environmentally, than social psychological variables. Thus, the examination of personality, in particular the broad dimensions of the Five-Factor Model or the Big Five (we refer to this as the Big Five throughout), and the HEXACO, may provide valuable insight into understanding why individuals do (not) act or think pro-environmentally.

Despite this, little attention had been paid to how these broader personality models are associated with pro-environmental attitudes and behaviours. An "early" study identified only three papers before 2012 that had examined these broader personality models' associations with pro-environmental attitudes and behaviours (Milfont & Sibley, 2012). With the earliest of these studies being published in 2007. This was for the most part supported by our meta-analysis on this topic (see Chapter 4). Since these early studies, there has been a growing number of studies that examined how these broader constructs of personality, using the

aforementioned models of the Big Five and HEXACO, were associated with pro-environmental attitudes and behaviours.

Although there had been some research into other models of personality (e.g. Eysenck's personality factors; Wiseman & Bogner, 2003), studies tended to use the Big Five, or HEXACO. The Big Five model of personality consists of five broad domains: Emotional Stability (Neuroticism), Extraversion, Openness, Agreeableness, and Conscientiousness. Neuroticism assesses the extent to which individuals are anxious, irritable, and emotionally (un)stable. Extraversion assesses the extent to which individuals are outgoing, talkative, and energetic. Openness assesses the extent to which individuals are creative, imaginative, and open to new ideas. Agreeableness assesses the extent to which individuals are compassionate, and display empathy or concern for others. Lastly, Conscientiousness assesses the extent to which individuals are self-disciplined and able to exert self-control. The HEXACO, adds a sixth dimension termed Honesty-Humility (which is associated with Agreeableness and Conscientiousness in the Big Five; Lee, Ashton, Choi, & Zachariassen, 2015). Honesty-Humility can be described as a tendency to cooperate with and avoid exploiting others. HEXACO Extraversion, Conscientiousness, and Openness are very similar to their equivalents in the Big Five (Lee et al., 2015), whereas Agreeableness and Emotionality differ slightly from their Big Five counterparts (Ashton, Lee, & de Vries, 2014; Lee et al., 2015).

Among these five (or six) domains Openness had been the most consistently associated with pro-environmental attitudes and behaviours (Brick & Lewis, 2016; Hirsh & Dolderman, 2007; Markowitz et al., 2012; Nisbet et al., 2009; Soliño & Farizo, 2014). Agreeableness had also been found to be associated with pro-environmental attitudes (Hirsh, 2010; Hirsh & Dolderman, 2007; Nisbet et al., 2009). However, some studies found a lack of an association between Agreeableness and pro-environmental attitudes (Lee et al., 2015; Markowitz et al., 2012). Similarly, Honesty-Humility tended to be positively associated with

pro-environmental attitudes and behaviours (Brick & Lewis, 2016; Hilbig et al., 2013), but non-existent or mixed associations had been found (Lee et al., 2015; Markowitz et al., 2012; Milfont, Milojev, Greaves, & Sibley, 2015). Findings for the other personality domains were less consistent (Brick & Lewis, 2016; Hirsh, 2014; Kvasova, 2015; Markowitz et al., 2012; Milfont & Sibley, 2012; Lee et al., 2015).

Despite the growing body of literature on personality's associations with pro-environmental attitudes and behaviours, and the inconsistency in findings, there had been to date no systematic review of these domain-level associations with pro-environmental attitudes and behaviours. This formed the motivation for Chapter 4, in which we carried out a systematic review of the literature, and performed a meta-analysis, to create a coherent picture of the Big Five's and HEXACO's domain-level associations with pro-environmental attitudes and behaviours.

1.5.3 Facet-Level Assessment

So far, this dissertation has discussed the broad domain-level research of the Big Five and HEXACO. What has not been mentioned is that this broad domain-level can be broken down into lower-level facets (Ashton & Lee, 2007; Costa & McCrae, 1992; John & Srivastava, 1999; Markowitz et al., 2012). This lower-level of analysis can be useful, because facets contain a substantial amount of unique information about how people differ in personality above and beyond the domains under which they are subsumed (e.g. Elleman, Condon, Holtzman, Allen, & Revelle, 2020; Elleman, McDouglad, Condon, & Revelle, 2020; Mõttus, 2016; Mõttus & Rozgonjuk, 2019; Paunonen & Ashton, 2001; Vainik et al., 2019). It might be the case that facets within a domain are associated with pro-environmental attitudes and behaviours in contradictory or inconsistent patterns (i.e. some positively associated, others negatively associated, and some not associated at all; Markowitz et al., 2012). In the extreme, such cases can cancel each other out, which would result in a null association at the

domain-level where they are aggregated (Soto & John, 2009). Past research had shown that studying personality's association with an outcome at a narrower level (e.g. facets) provided not only a greater understanding of personality's association with said outcome, but also provided a greater ability to predict outcomes from these personality traits (Mõttus & Rozgonjuk, 2019; Vainik et al., 2019).

Despite these potential benefits there had been little research that examined how facets were associated with pro-environmental attitudes and behaviours. Furthermore, the handful of studies that examined facet-level associations did not use consistent measures (and subsequently consistent facets), nor did any examine the predictive ability of these facets. This formed the motivation for Chapter 5, where we examined if facet-level, over domain-level, associations provided additional understanding of personality's associations with pro-environmental attitudes and behaviours. We also examined if this facet-level information provided additional predictive value for pro-environmental attitudes and behaviours, when compared to domain-level information.

1.6 Political Preferences and Pro-Environmental Attitudes and Behaviours

Another area of individual differences are political preferences. Political preferences had been associated with pro-environmental attitudes and behaviours in past research. A recent meta-analysis found that both political ideology and party affiliation were associated with pro-environmental attitudes (ρ = .22 to .29; Cruz, 2017). Other operationalisations of political preferences had also been found to be associated with pro-environmental attitudes and behaviours. One such study split political preferences between fiscal and social conservatism and found that fiscal, but not social, conservatism was negatively associated with pro-environmental attitudes (Allen, Castano, & Allen, 2007). In contrast, recent work in the EU suggested the opposite, in that those who were socially right-leaning were less likely to act pro-environmentally compared to those who were socially left-leaning (Azarova,

Cohen, Kollmann, & Reichl, 2019). Furthermore, those who were economically right-leaning were more likely to act pro-environmentally, while those who were economically left-leaning were not associated with acting pro-environmentally. Another study, taking a broader and simpler operationalisation of political preferences, found that political conservatism was negatively associated with pro-environmental attitudes, but not with pro-environmental behaviours (Brick & Lewis, 2016). Despite these inconsistencies, generally Conservative individuals were found to be less or negatively associated with pro-environmental attitudes when compared to Liberal individuals. This divide or political polarisation can be seen clearly in beliefs regarding environmental issues, such as climate change (Pew, 2015) and global warming (Pew, 2017).

Research had been conducted into why these political differences were found when it comes to environmental issues, such as climate change. One potential reason for these differences was suggested to be due to the terminology used around environmental issues. (In)famously a 2002 memo, was written for the Republican Party (Luntz, 2002). In this memo it was suggested that Republicans should describe themselves as conservationists, rather than preservationists or environmentalists, as the former had more positive connotations. Furthermore, it was suggested that the term climate change, rather than global warming, be used, as the former had more positive connotations. Although this pointed to the idea that terminology might explain these political differences in pro-environmental beliefs, empirical evidence is needed. One such study that examined whether differences in terminology might explain political differences in pro-environmental beliefs was conducted in 2009 (Schuldt, Konrath, & Schwarz, 2011).

This study experimentally manipulated whether participants read about climate change or global warming, and asked participants to indicate their level of belief in the phenomena presented. It was found that there was a significant difference in beliefs between

the two terms, and that this was driven by Republicans. Specifically, it was found that Republicans believed more in climate change than they did in global warming. These findings were replicated by Schuldt and colleagues in the United States of America (USA), who found the same effect over time (Schuldt, Enns, & Cavaliere, 2017; Schuldt, Roh, & Schwarz, 2015). Thus, terminology might not only potentially explain political polarisation in pro-environmental attitudes and behaviours, but also inform potential interventions to reduce this political polarisation. However, the findings of other studies suggested a limit to the universal replicability of this effect (Dunlap, 2014; Villar & Krosnick, 2011). Furthermore, this finding had not been directly assessed outside of the USA. This formed a motivation for Chapter 6, where we conducted a pre-registered large cross-country replication to see whether a) this effect was independently replicable, and b) if it replicated to other contexts.

1.6.1 Political Preferences and Personality

This dissertation has so far discussed two major areas of individual differences, personality and political preferences. Although these are separate areas of individual differences, they are associated with each other. A meta-analysis of personality (i.e. the Big Five) and political preferences found that Openness was negatively associated with political conservatism, and that Conscientiousness was positively associated with it (Sibley, Osborne, & Duckitt, 2012). Despite the connection between personality and political preferences, little research had been conducted on how political preferences were associated with pro-environmental attitudes and behaviours, when controlling for personality traits (Brick & Lewis, 2016). One study that had, found that political conservatism had no association with pro-environmental behaviours when controlling for personality traits (Brick & Lewis, 2016). Due to this they suggested that interventions promoting pro-environmental behaviours should target personality differences, rather than political preferences, in order to be effective. This formed the motivation for Chapter 7 in which we examined a) whether the findings of

Schuldt and colleagues (2011) remained when controlling for personality traits, and b) the associations between political preferences and several pro-environmental attitudes and behaviours when controlling for personality traits.

1.7 Present Research Aims and Questions

This dissertation involved itself with the examination of what types of people do (not) care or act pro-environmentally and examined or suggested potential mechanisms to promote pro-environmental attitudes and behaviours. Specifically, this dissertation focused on the individual differences of personality and political preferences. This dissertation can be broken down into three broad parts.

Part 1. How to measure pro-environmental attitudes and behaviours?

Chapter 2: In this chapter we created two new measures, which assessed pro-environmental attitudes and behaviours. The factor structure of these measures was then assessed, and their validity tested alongside an existing measure of pro-environmental behaviours.

Chapter 3: In this chapter we extended our examination of pro-environmental attitudes and behaviours and examined several existing measures of pro-environmental attitudes and behaviours. Here we assessed the test-retest reliability, internal consistency, and predictive validity for pro-environmental behaviours of several existing pro-environmental attitudes measures alongside our newly established measures from Chapter 2. Furthermore, we examined the concurrent validity of our newly established measures. This chapter aimed to extend the psychometric assessment of our newly established measures, and to determine which pro-environmental attitudes measures would be the most useful for further studies within this dissertation.

Part 2. What was the personality profile of individuals who acted pro-environmentally? And how can this inform interventions promoting pro-environmental attitudes and behaviours?

Chapter 4: In this chapter we examined personality's associations with pro-environmental attitudes and behaviours. A meta-analysis of the existing literature, that examined how the broad domains of the Big Five and HEXACO were associated with various pro-environmental attitudes and behaviours was conducted. Furthermore, we examined the predictive ability of our meta-analytic model. This chapter concluded with a discussion on how this information could be used to promote pro-environmental attitudes and behaviours.

Chapter 5: This chapter built upon Chapter 4 and examined whether facet-level information provided a more nuanced understanding of personality's associations with pro-environmental attitudes and behaviours, compared to the domain-level information examined in Chapter 4. Furthermore, we examined whether this facet-level information provided additional predictive value for pro-environmental attitudes and behaviours, when compared to domain-level information. This chapter concluded with a discussion on how this information could be used to promote pro-environmental attitudes and behaviours, and the direction that research in this understudied area could take.

Part 3. How are political preferences associated with pro-environmental attitudes and behaviours? And how can this inform interventions promoting pro-environmental attitudes and behaviours?

Chapter 6: This chapter attempted to replicate an earlier finding that the terminology (climate change versus global warming) used can alter beliefs in environmental phenomena; and that this was specifically found amongst Conservative individuals. We attempted to

replicate this finding in the original context (USA), as well as the United Kingdom (UK) and Australia. This chapter concluded with a discussion on how terminology could be used as a potential path for pro-environmental attitudes and behaviours change, as well as the associations political preferences had with pro-environmental beliefs.

Chapter 7: This chapter, conducted alongside Chapter 6, built upon the study replicated in Chapter 6, and examined various operationalisations of political preferences, several pro-environmental attitudes and behaviours, and personality traits. This chapter had several aims. Firstly, it aimed to examine whether the interaction between question wording and political preferences on pro-environmental beliefs changed when controlling for personality traits and different operationalisations of political preferences. Secondly, it aimed to understand the associations political preferences had with pro-environmental attitudes and behaviours when controlling for personality traits. This chapter concluded with a discussion on how political preferences should be operationalised in future studies, as well as how political preferences and personality could be used to promote pro-environmental attitudes and behaviours.

Finally, Chapter 8 (general discussion) summarised the main findings of this dissertation identified in previous chapters and contextualised them in the wider literature. It then discussed the limitations of the work within this dissertation and provided future directions for research on understanding the psychology behind pro-environmental attitudes and behaviours, with a focus on individual differences research.

Part 1: On Measuring Pro-Environmental Attitudes and Behaviours

As discussed in Chapter 1, there are numerous ways to measure pro-environmental attitudes and behaviours. Despite the numerous measures to assess pro-environmental attitudes and behaviours there had been no consensus on a gold-standard to measure these attitudes and behaviours. Within pro-environmental attitudes some of the most commonly used measures included the Ecology Scale (Maloney & Ward, 1973; Maloney et al., 1975), the ECS (Weigel & Weigel, 1978), and the NEP (Dunlap & Van Liere, 1978; Dunlap et al., 2000). Despite their use in the wider literature these measures had several limitations, with no clear guidance as to which was the best measure to use. Furthermore, for pro-environmental behaviours a review found that there was little consistency in measures used within the wider literature (Markle, 2013). Regarding a general measure of pro-environmental behaviours, only the GEB (Kaiser, 1998) and the PEBS (Markle, 2013) had seen some wider use in the literature. The following chapters attempted to address these issues.

In Chapter 2 we provided a more thorough overview and discussion on the limitations of some widely used pro-environmental attitudes and behaviours measures. To address these issues two new measures, which assessed pro-environmental attitudes and behaviours, were created. Furthermore, an initial assessment of the predictive and concurrent validity, respectively, of these new measures was conducted. In Chapter 3 we expanded on Chapter 2 and provided a broader review of existing pro-environmental attitudes measures. Furthermore, in Chapter 3 we assessed the test-retest reliability, internal consistency, and predictive validity for pro-environmental behaviours of various existing pro-environmental attitudes measures, alongside our newly established pro-environmental attitudes measure. Lastly, in Chapter 3 we examined the concurrent validity of our new pro-environmental attitudes and behaviours measures.

Chapter 2: The Development of Pro-Environmental Attitudes and Behaviours Measures

2.1 Introduction

Pro-environmental attitudes can be broadly defined as one's tendency to exhibit favour towards the natural environment (Hawcroft & Milfont, 2010; Milfont, 2007). Environmental and conservation psychology has primarily focused on these pro-environmental attitudes, despite this, there is currently no gold-standard measure of pro-environmental attitudes (Hawcroft & Milfont, 2010; Milfont, 2007; Saunders, 2003). This has resulted in an "anarchy of measurement" in the study of pro-environmental attitudes (Stern, 1992, p. 279), with a review showing that in many studies a new pro-environmental attitudes measure was created and used (Dunlap & Jones, 2002; Hawcroft & Milfont, 2010). One reason for this is that no existing pro-environmental attitudes measure captures all the aspects of pro-environmental attitudes, and there is no clear guidance on which measure of pro-environmental attitudes is the best to use. The advantages and disadvantages of existing pro-environmental attitudes measures will now be discussed.

Previous research had identified that the three most widely used measures of pro-environmental attitudes were the Ecology Scale (Maloney & Ward, 1973; Maloney et al., 1975), the ECS (Weigel & Weigel, 1978), and the NEP (Dunlap & Van Liere, 1978; Dunlap et al., 2000; Hawcroft & Milfont, 2010). These measures all assessed pro-environmental attitudes towards multiple environmental phenomena or concerns, making them all multiple-topic assessment techniques (Dunlap & Jones, 2002). Although the Ecology Scale and ECS were widely used, they had become dated in recent times, with some of their items referring to issues that had become less prominent as new environmental issues emerged, and supplanted them (Dunlap & Jones, 2002, 2003; Hawcroft & Milfont, 2010). The NEP was more robust to these changes in prominence of various environmental issues, as it measured more general beliefs about people's relationship with the natural environment (Hawcroft & Milfont, 2010).

The NEP avoided the issue of becoming dated by measuring general pro-environmental concern, rather than attitudes towards specific environmental issues (Dunlap et al., 2000; Stern, Dietz, & Guagnano, 1995). This was a strength of this measure as it enabled researchers to capture attitudes towards earth's global ecological crisis, rather than community or environmentally specific issues (e.g. wolves; Dunlap et al., 2000). Despite being widely used, the NEP had been critiqued. The main critique being that it was perhaps too cognitive a measure of pro-environmental attitudes, to the exclusion of the emotive aspects of pro-environmental attitudes (Hirsh & Dolderman, 2007). This was problematic as the emotive aspects of pro-environmental attitudes were found to be important for wider environmentalism and had strong associations with pro-environmental behaviours (e.g. Kals, Schumacher, & Montada, 1999).

Although the NEP did not examine the emotive aspects of pro-environmental attitudes, several other measures had. One group of measures did this by assessing an individual's connection to nature (Frantz & Mayer, 2014). The Emotional Affinity Toward Nature measure was perhaps the first to assess this emotive connection to nature (Kals et al., 1999; Tam, 2013b). It was shown that these emotive aspects were distinct from cognitive aspects of pro-environmental attitudes, and that they were associated with pro-environmental behaviours (Kals et al., 1999). Since this original measure, several measures were developed to assess these emotive aspects of pro-environmental attitudes, with the most widely used being the CNS (Frantz & Mayer, 2014). The CNS was found to be consistently associated with pro-environmental behaviours and explained the associations between other variables and pro-environmental behaviours (e.g. Openness' association with pro-environmental behaviours was mediated by the CNS when combined with the NEP; Frantz & Mayer, 2014; Markowitz et al., 2012).

This combination of the NEP, a cognitive measure, with more emotive measures was done elsewhere. One such study found that the ability to explain pro-environmental behaviours was increased when combining the NEP with Kellert's typologies (another emotive measure; Rauwald & Moore, 2002). Thus, it is clear that combining pro-environmental attitudes measures that assessed cognitive and emotive aspects of pro-environmental attitudes, increased the ability to explain, from these attitudes, one's tendency to act pro-environmentally.

So far, this discussion has focused on pro-environmental attitudes, and their association with pro-environmental behaviours. Where pro-environmental attitudes are the tendency to exhibit favour towards the natural environment (Hawcroft & Milfont, 2010; Milfont, 2007); pro-environmental behaviours can be described as concrete actions (including the behaviour of not taking an action), whether deliberate or not, that positively impacts the natural environment (e.g. recycling, purchasing organic products, and water or energy reduction; Lange & Dewitte, 2019). Although research into these pro-environmental behaviours began in the 1970s there is currently no gold-standard or consistently used pro-environmental behaviours measure, with most studies creating new items to measure their specific pro-environmental behaviours of interest (e.g. acceptability of environmental taxation; Kim, Schmöcker, Bergstad, Fujii, & Gärling, 2014; Markle, 2013). Despite this, general measures of pro-environmental behaviours do exist.

The GEB (Kaiser & Wilson, 2000) and the PEBS (Markle, 2013) are two of the more prominent measures of general pro-environmental behaviours. Although the GEB was originally stated to consist of seven subscales, it was updated with more items, and is scored as a single measure (Kaiser & Wilson, 2000). A major advantage of this measure was that it was originally designed to account for the different levels of difficulty of pro-environmental behaviours, through a Rasch model (Kaiser & Wilson, 2000). However, a problem with this

measure was that a few items appeared to have little environmental impact (e.g. “If possible, I do not insist on my right of way and make the traffic stop before entering a crosswalk”). Markle (2013) attempted to address this with the PEBS, which examined individuals’ pro-environmental behaviours that had the greatest impact on the natural environment. However, widespread adoption of these general pro-environmental measures was lacking in the wider literature.

So far in this dissertation we have used the term gold-standard without clearly defining it. Generally speaking, a gold-standard measure would the measure that best assess the concept of interest. This might appear a simple metric at first, where one chooses a measure that most accurately represents the reality of the phenomena being examined. For example, if one wishes to measure someone’s reaction time in milliseconds an atomic clock would be a gold-standard compared to a normal wristwatch. However, when it comes to psychological concepts this idea becomes more complicated, for two reasons. First, is the (in)ability to measure concepts that are more abstract in nature (e.g. attitudes). Second, is what one’s definition and goal of measuring pro-environmental attitudes and behaviours are, determines what would be the best measure.

To answer the first limitation of gold-standards in psychology, we suggest that a gold-standard measure of pro-environmental attitudes and behaviours would be one that reliably measures an individual’s pro-environmental attitudes and behaviours, and that this measurement is associated with expected outcomes (e.g. pro-environmental behaviours). For example, an individual’s pro-environmental attitudes score on this hypothetical gold-standard should be consistent over time (assuming the individual’s attitude does not change), be able to detect changes in these attitudes, and be associated strongly with pro-environmental behaviours (as attitudes should to some extent predict behaviours). In psychology these evaluations can be assessed via test-retest reliability, and various forms of validity (e.g.

predictive and concurrent). Thus, a gold-standard measure should score highly on these psychometrics, and out-perform alternative measures.

The second limitation is more complicated as it is subjective. For example, if one's definition and goal of measuring pro-environmental attitudes is to assess one's emotive connection to elephants, a measure that assesses cognitive attitudes towards nature in general would not be an ideal measure. As by design it would be broader in focus. Similarly, if one was interested and defined pro-environmental behaviours as recycling, a measure that asks about travel habits would have little utility over a measure that directly asses recycling. Thus, when it comes to this second evaluation, it is subjective in nature, in that a gold-standard would be the one most relevant to the definition/goal of the researcher. For the purposes of this dissertation, our definition/goal in studying pro-environmental attitudes and behaviours, was to capture an individual's pro-environmental attitudes and behaviours broadly, rather than any specific subset.

Thus, for us, a gold-standard measure for pro-environmental attitudes would be one that assesses a general positive favouring of the natural environment, both cognitively and emotively, that is reliable over time and is strongly associated with pro-environmental behaviours. This formed a motivation for this present study, which was to develop a pro-environmental attitudes measure that assessed both cognitive and emotive aspects of pro-environmental attitudes and was general rather than problem specific. Regarding pro-environmental behaviours a gold-standard measure, for us, would be one that measures a broad range of pro-environmental behaviours, rather than any specific subset of behaviours. This formed a motivation for this present study, which was to develop a general pro-environmental behaviours measure.

2.1.1 Present Study

This study had two main aims. Firstly, this study aimed to assess the factor structure of two newly created measures, which measured pro-environmental attitudes and behaviours. The second aim of this study was to test the validity of these new measures. This would be done by assessing how the newly created pro-environmental attitudes measure associated with an established pro-environmental behaviours measure, as well as the newly created pro-environmental behaviours measure. Furthermore, the concurrent validity of the newly created pro-environmental behaviours measure would be assessed by examining how it associated with an existing pro-environmental behaviours measure. For this second aim, three hypotheses were developed.

Hypothesis 1: The newly created pro-environmental attitudes measure would be moderately and positively associated with pro-environmental behaviours as measured by the GEB.

Hypothesis 2: The newly created pro-environmental attitudes measure would be moderately and positively associated with pro-environmental behaviours as measured by the newly created pro-environmental behaviours measure.

Hypothesis 3: The newly created pro-environmental behaviours measure would be strongly and positively associated with the GEB.

2.2 Method

2.2.1 Participants

Participants (N = 164) were recruited from various online sources, including social media platforms (e.g. Facebook and Reddit), and online research websites (e.g. Social Psychology Network, Psychology Research On the Net, and SurveyCircle). Participants

received no compensation for their participation in this study. No information was collected regarding any characteristics (e.g. gender and age) of participants.

2.2.2 Measures

An initial pilot study (N = 115) was conducted, which asked participants what they thought the environment was, how it made them feel, what they liked/disliked about the environment, what they considered pro- and anti-environmental attitudes and behaviours, and what pro-environmental behaviours they participated in. These qualitative responses formed the basis of items used within the newly developed pro-environmental attitudes and behaviours measures.

Regarding pro-environmental attitudes items, this was initially done by reading responses and categorising them as: a feeling, what someone liked/disliked about the environment, and what was pro- or anti-environmental. Once all responses were grouped into these five broad categories, these categories were then examined for consistent themes or patterns in responses. This resulted in thirteen themes (Climate change is a serious problem, Human responsibility to minimise/mitigate, Caring/appreciation of nature, Pro-science/education, Regulating human impact, Future/other thinking, Capitalistic/materialistic, Human superiority, Benefit of environment, Preservation, Environment makes me feel, Environmental likes, Environmental dislikes), which had at least 4 items written per theme. Lastly, a single item was created which did not fit into any theme but stood out “Sometimes pro-environmental people are very aggressive and in-your face about it”.

Regarding pro-environmental behaviours items, responses were categorised as pro- or anti-environmental. These responses were then examined for any consistent themes, or regularly stated behaviours, which created the initial set of items. As there was a lack of

variety in behaviours, to this initial set we added some items that were not mentioned but were pro-environmental in nature.

2.2.2.1 Pro-environmental attitudes. This measure consisted of 58 items on which participants rated their agreement with each item on a 5-point Likert scale, ranging from 1 (*Strongly Disagree*) to 5 (*Strongly Agree*). See Appendix A.1 for all items.

2.2.2.2 Pro-environmental behaviours. This measure consisted of 19 items which participants rated how frequently they performed each item on a 5-point Likert scale, with the responses of 1 (*Never*), 2 (*Sometimes*), 3 (*About half the time*), 4 (*Most of the time*), and 5 (*Always*). Participants also had the option to select "Not applicable". See Appendix A.2 for all items.

2.2.2.3 GEB. A 30-item version of the GEB was used. Participants responded to these items on a yes/no format (Kaiser & Biel, 2000). Past research found that this measure had a KR-20 of .73 (Kaiser & Biel, 2000), and in this study it had a KR-20 of .61 indicating acceptable internal consistency.

2.2.3 Procedure

This study was approved by the University of Edinburgh Human Research Ethics Committee. Participants completed the survey online, via Qualtrics. Participants first completed the newly created pro-environmental attitudes measure, followed by the newly created pro-environmental behaviours measure, and lastly the GEB. Items within these measures were presented in a randomised order.

2.3 Results: Measure Creation

2.3.1 Exploratory Factor Analysis Criteria

While exploratory factor analysis is exploratory in nature, we did use certain criteria to determine which model would be preferred, and what items would be dropped.

The first criteria we applied was that all items should be directly relevant to assessing a general measure of pro-environmental attitudes or behaviours. This was done by assessing the face validity of items, examining each item and removing any items that were not clearly associated with pro-environmental attitudes and behaviours. This was done to ensure that only items of relevance would be included in the factor analysis. The second criteria that was applied before factor analysis was the removal of items with an overabundance of low or high correlations. It is advised that items with an overabundance of low correlations, $|r| < .30$, or high correlations, $|r| > .90$, are removed before conducting factor analysis (Field, Miles, & Field, 2012; Tabachnick & Fidell, 2007). These items were removed as items with too few correlations, or too many high ones are problematic for creating clusters of items (i.e. factors or components) or assessing the unique contribution an item has to a factor (Field et al., 2012). This was supplemented by performing Bartlett's tests to ensure that there were enough correlations between items to perform a factor analysis. There is no clear criteria for what is considered too many or too few correlations, however we decided on a cut-off of 12%, rounding to the nearest whole number (i.e. items had to correlate with at least 12% of the other items above |.30| and no more than 12% with the other items above |.90|). This cut-off was used as it was not too restrictive of a threshold, and practically meant that not too many items were removed before factor analysis. Furthermore, a percentage, over a set number, was chosen to account for the difference in the number of items created to assess pro-environmental attitudes and behaviours.

The remaining criteria were used during or after factor analysis. The first criteria used was a parallel analysis. This statistical analysis was used to give an initial insight into how many factors to examine. This was supplemented by using the scree plot. This gave an initial starting point for how many factors were assessed in the subsequent factor analysis. The next criteria examined the item loadings. To create a cut-off for what was considered a sufficient

loading, we considered an item to sufficiently load on to a factor when its loading was greater than |.32| based on past research (Tabachnick & Fidell, 2007). If items were not loaded on any factor they were dropped from the model as they were determined not to contribute significantly to the underlying constructs of pro-environmental attitudes or behaviours. Once all items were removed that did not load on any factor, the factors and the items that loaded on to them were examined in more detail.

First, the unique loadings to a factor were examined. If a factor had few unique loadings, these additional factors were determined to provide little additional value, and thus simpler models were examined. For example, if a model had three factors but one factor only had one unique loading a two-factor model would be examined even if this was not initially suggested by the parallel analysis. Second, when comparing models, more parsimonious solutions were preferred, which was defined by models with the fewest number of factors. These simpler models were preferred as they provided more interpretable factors. Furthermore, models with less parsimony tend to be more reflective of sample specific variation rather than actual associations (i.e. they might explain the data they were trained on well but are less useful in other sample sets). Lastly, models were also compared on their theoretical support, where existing measures of pro-environmental attitudes and behaviours informed the structure of our models of pro-environmental attitudes and behaviours.

2.3.2 Pro-Environmental Attitudes

2.3.2.1 Data preparation

An initial assessment of the content of items was conducted. Due to this assessment two items, item 28 (“The more someone has the better off they are”) and item 42 (“Sometimes pro-environmental people are very aggressive and in-your face about it”), were removed, due to their lack of clear relevance to pro-environmental attitudes. A correlation matrix of the remaining items was then carried out in order to assess the associations between

items. This assessment revealed that 12 items (item 11, 12, 20, 31, 39, 44, 46, 49, 51, 55, 56, and 57) should be removed, as they had seven or fewer correlations greater than or equal to $|r| = .30$. Bartlett's test was significant indicating that the remaining items provided enough correlations of sufficient strength to continue with factor analysis. However, the calculated determinant was lower than .00001 which indicated a potential problem of multicollinearity.

2.3.2.2 Exploratory factor analysis

An initial parallel analysis was performed in order to find the optimal number of factors. This parallel analysis suggested that there were four factors and three components. Theoretically aspects of pro-environmental attitudes are associated with each other, therefore oblimin rotations were used for these extracted factors. The four-factor model explained 51% of the variance in items, and the three-factor model explained 48% of the variance in items. The loadings of items on factors was then examined. This assessment of item loadings revealed that for the four-factor model, two of its factors only had one or two items uniquely loaded on to them, with all other items cross-loaded on to another factor. Likewise, the three-factor model had one factor with only one item uniquely loaded on to it with all other items cross-loaded on to another factor. For this reason, a two-factor model was also examined, which explained 44% of the variance in items.

An iterative process of removing items with loadings below the threshold of |.32| was then conducted. The four-factor model (Appendix A.3) had 6 items removed from it and explained 54% of the variance in the remaining items. The three-factor model (Appendix A.4) had two items removed from it and explained 49% of the variance in the remaining items. The two-factor model (Appendix A.5) had three items removed from it and explained 45% of the variance in the remaining items. The three-factor model and four factor model still contained one and two factors, respectively, with only one item uniquely loaded on to

them. Due to this, a preference for a parsimonious solution, and past theoretical research (Milfont & Duckitt, 2010), the two-factor model was preferred.

The content of items that loaded on to the factors of the two-factor model were examined. This examination found that the items loaded on to one factor were positive attitudes towards the natural environment and was labelled as the "pro-environmental" subscale, the other factor contained items that contained negative attitudes towards the natural environment and was labelled as the "anti-environmental" subscale. These two factors correlated strongly, r = -.59. As these factors correlated strongly with each other, appeared to simply be opposites of the other, an examination of the scree plot, and with many existing pro-environmental attitudes measures treating pro-environmental attitudes as unidimensional (Milfont & Duckitt, 2010), a one-factor model was examined. This one-factor model explained 39% of the variance in the items from the two-factor model, a drop of six percentage points. With the removal of one item that failed to load on to this single factor, the one-factor model explained 40% of the variance in the remaining items. This final model was preferred over the two-factor model, as it was more parsimonious, explained a similarly high level of variance, and had theoretical grounding. This final model was labelled the "Environmentalism Scale" (ES; see Appendix A.6).

2.3.3 Pro-Environmental Behaviours

2.3.3.1 Data preparation

An initial assessment of the content of items was conducted and revealed that all items appeared to be relevant for assessing pro-environmental behaviours. A correlation matrix was created to examine the correlations between pro-environmental behaviours. Two items (4 and 6) were removed as they had one or no correlations that were greater to or equal to $|r|$ = .30. Bartlett's test was significant indicating that the remaining items provided enough

correlations of sufficient strength to continue with factor analysis. The calculated determinant was greater than .00001 which indicated there was no potential issue of multicollinearity.

2.3.3.2 Exploratory factor analysis

An initial parallel analysis was performed in order to find the optimal number of factors. This parallel analysis suggested that there were four factors and two components. Theoretically pro-environmental behaviours are associated with each other, thus oblimin rotations were used for these extracted factors. The four-factor model explained 50% of the variance in items, and the two-factor model explained 40% of the variance in items. The loadings of items on factors were then assessed. This assessment of item loadings revealed that the four-factor model had several problems. Firstly, one factor only had a single item loaded on to it, which cross-loaded on to another factor. Secondly another factor had one item having a factor loading greater than one. Thus, the two-factor model was preferred. Furthermore, the two-factor model (Appendix A.7) was preferred, as although it explained less variance, it was more parsimonious.

An iterative process of removing items was not necessary as all items loaded on to at least one factor above the threshold of |.32|. The correlation between factors was moderate r = .36. The content of items that loaded on to the two-factor model was subsequently examined. There appeared to be no theoretical or rational reason for why some items loaded on one factor and not the other. This lack of interpretability combined with half the items cross-loading prompted an examination of a one-factor model. This one-factor model explained 34% of the variance in items, a drop of six percentage points, with only one item needing to be removed due to not loading. This one-factor model (Appendix A.8) appeared to be more interpretable than the two-factor model, and was more parsimonious, and was thus preferred. The final one-factor model was labelled as the “Environmental Behaviour” (EB) measure.

2.4 Results: Validity

2.4.1 Hypothesis One

It was hypothesised that the newly created pro-environmental attitudes measure would be moderately and positively associated with pro-environmental behaviours as measured by the GEB. A Pearson's correlation was performed between the ES and the GEB. This analysis revealed a significant, positive, and strong correlation, $r = .52$, $p < .001$, which suggested that the ES shared 27.0% of the variance in scores on the GEB.

2.4.2 Hypothesis Two

It was hypothesised that the newly created pro-environmental attitudes measure would be moderately and positively associated with pro-environmental behaviours as measured by the newly created pro-environmental behaviours measure. A Pearson's correlation was performed between the ES and the EB. This analysis revealed a significant, positive, and moderate correlation, $r = .37$, $p = .007$, which suggested that the ES shared 13.7% of the variance in scores on the EB.

2.4.3 Hypothesis Three

The last hypothesis was that the newly created pro-environmental behaviours measure would be strongly and positively associated with the GEB. A Pearson's correlation was performed between the EB and the GEB. This analysis revealed a significant, positive, and strong correlation, $r = .48$, $p = .001$, which suggested that the EB shared 23.0% of the variance in scores on the GEB. This suggested that while this newly created pro-environmental behaviours measure was strongly associated with an existing measure of pro-environmental behaviours, it provided value separate to the GEB.

2.5 Discussion

2.5.1 Factor Structure of Measures

The first aim of this study was to examine the factor structure of two newly created measures, which assessed pro-environmental attitudes and behaviours. Through the exploration of items and their loadings, removing items that were not loaded on to any factor, and attempting to fit the most parsimonious model, it was found that both the pro-environmental attitudes and pro-environmental behaviours measures were unidimensional (despite parallel analysis initially having suggested that they were multidimensional).

2.5.1.1 Pro-environmental attitudes

The analysis of pro-environmental attitudes items initially suggested four factors and three components which conformed with some theories that pro-environmental attitudes were multidimensional (Milfont & Duckitt, 2010). However, a two-factor model was preferred over this initial four- and three-factor model for several reasons. Although this two-factor model was preferable, an examination of its items, revealed that the two factors appeared to simply be opposites of each other, thus, to preference a parsimonious model, and with theoretical and statistical support, this was reduced to a one-factor model. This one-factor model was found to be interpretable and explained a large amount of the variance in items. This unidimensional model of pro-environmental attitudes also conformed with some existing interpretations of pro-environmental attitudes (Milfont & Duckitt, 2010).

2.5.1.2 Pro-environmental behaviours

The analysis of the pro-environmental behaviours items initially suggested four factors and two components. Both these models were tested, and it was found that the four-factor model had several problems. Thus, the two-factor model was preferred. However, an examination of factor loadings provided no interpretable solution. Thus, like pro-

environmental attitudes, a one-factor model was examined. This one-factor model was found to be interpretable, and for parsimonious reasons was preferred over the two-factor model. This unidimensional model of pro-environmental behaviours conformed to how pro-environmental behaviours were generally treated in the literature (Larson, Stedman, Cooper, & Decker, 2015).

2.5.2 Validity

The second aim of this study was to assess the validity of these newly created measures. The hypotheses that the newly created pro-environmental attitudes measure would be moderately and positively associated with pro-environmental behaviours, as measured by the GEB and the newly created pro-environmental behaviours measure was supported. It was found that the ES was significantly, positively, and moderately to strongly, associated with the GEB and the EB. This was in line with past research, which suggested that pro-environmental attitudes should be associated with pro-environmental behaviours (Kollmuss & Agyeman, 2002; St. John, Edwards-Jones, & Jones, 2010). This suggested that the ES had predictive validity as its expected association with pro-environmental behaviours was found. However, further research is required to assess if the ES continues to demonstrate this predictive validity with other pro-environmental behaviours measures, and whether it demonstrates concurrent validity with other pro-environmental attitudes measures.

Lastly, it was hypothesised that the newly created pro-environmental behaviours measure would be strongly and positively associated with the GEB. This was supported which suggested that the EB had concurrent validity, while still providing additional value separate from the GEB. However, as with the ES, more research is needed to assess whether the EB demonstrates this concurrent validity with other pro-environmental behaviours measures, as well as if it is associated with existing pro-environmental attitudes measures.

2.6 Conclusion

In conclusion, this study assessed the factor structure of two newly created measures, which assessed pro-environmental attitudes and behaviours. This resulted in two unidimensional measures, the ES and the EB. It was found that the ES, was associated with pro-environmental behaviours, and that the EB measure demonstrated concurrent validity. This study was however limited in two main ways. Firstly, the sample size of this study could be improved, as factor analysis is data intensive. Secondly, due to temporal constraints only a single existing measure of pro-environmental behaviours was assessed alongside these two new measures. This limited the psychometric properties that could be assessed in this study. Chapter 3 addressed this and further examined the psychometric properties of these newly established measures. This was done by testing the test-retest reliability, internal consistency, and predictive and concurrent validity of the newly created pro-environmental attitudes measure, alongside several other existing pro-environmental attitudes and behaviours measures. Chapter 3 also examined the concurrent validity of the newly created pro-environmental behaviours measure. Furthermore, a greater sample size was acquired in future studies, to ensure results were reliable and valid. Despite these limitations, this study created a pro-environmental attitudes measure that was associated with pro-environmental behaviours, which indicated predictive validity, and a pro-environmental behaviours measure that demonstrated concurrent validity.

A Correction to Chapter 2

In Chapter 2 a 40-item pro-environmental attitudes measure, the ES, was created, as well as a 16-item pro-environmental behaviours measure, the EB. However, an error in matching item wordings to item numbers occurred. This resulted in slightly different items being presented to participants in the studies reported in Chapter 4, 5, and 7. This error and a subsequent factor analysis of the items that were used in these measures in these subsequent chapters will now be discussed.

Regarding the ES, two items "I care if my actions negatively impact the environment" and "We do not have the right to do anything we want to the environment" were omitted in the presentation of this measure in the studies reported in Chapter 4, 5, and 7. A factor analysis of this reduced measure was conducted in a similar process as that used in Chapter 2. Firstly, a correlation matrix was created between the 38 items, in order to remove any items with an overabundance of low correlations, $|r| < .30$, or high correlations, $|r| > .90$. No items were removed as neither of these criteria were met. Bartlett's test was significant indicating that the remaining items provided enough correlations of sufficient strength to continue with factor analysis. However, the calculated determinant was lower than .00001 which suggested a potential problem of multicollinearity.

A parallel analysis was performed to find the optimal number of factors, which suggested that there were three factors and components. Theoretically pro-environmental attitudes are associated with each other, thus oblimin rotations were used for these extracted factors. The three-factor model explained 51% of the variance in items. One item ("Mass consumerism negatively impacts the environment") was removed as it failed to load on to any factor. The three-factor model now explained 51% of the variance in items. However, one

factor had only two items uniquely loaded on to it. Thus, as in Chapter 2, a two- and one-factor model were also examined. The two-factor model explained 46% of the variance in items, and the one-factor model explained 40% of the variance in items. In both of these models all items loaded on to at least one factor. An investigation of the items revealed that the two-factor model again appeared to create a “pro-environmental”, and an “anti-environmental” subscale, which correlated strongly, r = -.59. The one-factor model was preferred for several reasons. Firstly, there was a strong correlation between factors in the two-factor model, which appeared to be opposites of the other. Secondly, there was theoretical grounding for a one-factor model. Lastly, the one-factor model was more parsimonious while explaining a similarly high level of variance in the items. This one-factor model was used in the analysis of Chapter 3, 4, 5, and 7. This one-factor solution, as well as the two- and three-factor solutions can be found in Appendix A.9.

Regarding the EB, two items “I try and eat less meat” and “I buy environmentally friendly products” were replaced with three items “I support hunting”, “I support fracking and oil expansion”, and “Take public transport or walk instead of using a car”, in the presentation of this measure in the studies reported in Chapter 4, 5, and 7. A factor analysis of this altered measure was conducted in a similar process as that used in Chapter 2. Firstly, a correlation matrix was created between the 17 items, in order to remove any items with an overabundance of low correlations or high correlations. Two items (“I support hunting” and “I invest money in environmental research or renewable energies”) were removed as they had one or no correlations that were greater to or equal to $|r|$ = .30. Bartlett’s test was significant indicating that the remaining items provided enough correlations of sufficient strength to continue with factor analysis. The calculated determinant was greater than .00001 which suggested that there was no potential issue of multicollinearity.

A parallel analysis was performed in order to find the optimal number of factors, which suggested that there were three factors and two components. Theoretically pro-environmental behaviours are associated with each other, thus oblimin rotations were used for these extracted factors. The three-factor model explained 46% of the variance in items, and the two-factor model explained 42% of the variance in items. A one-factor model was also assessed due to the findings of Chapter 2. This one-factor model explained 33% of the variance in items. An iterative process of removing items with loadings below the threshold of |.32| was then conducted. One item ("I protest against un-environmental policies/construction") was removed from the three-factor model, which then explained 48% of the variance in items. One item ("I support fracking and oil expansion") was removed from the one-factor model, which then explained 35% of the variance in items. Although explaining the most amount of variance in items, the three-factor model did not create interpretable factors. The two-factor model's second factor only had two items uniquely loaded on to it. Thus, the one-factor model was preferred, despite explaining less variance in items, as it did not suffer from any of these issues and was the most parsimonious model. This one-factor model was used in the analysis of Chapter 3, 4, 5, and 7. This one-factor solution, as well as the three- and two-factor solutions can be found in Appendix A.10.

Although the study reported in Chapter 3 presented all the items as in Chapter 2, these revised measures reported here will be used in Chapter 3 and all subsequent chapters using these measures. This was to ensure consistency across chapters, and to ensure that the test-retest reliability, internal consistency, and validity of the ES and EB used in future chapters were examined.

Chapter 3: The Reliability, Internal Consistency, and Validity of Pro-Environmental Attitudes

3.1 Introduction

As mentioned in the previous chapter there are many measures of pro-environmental attitudes. This abundance of measures was problematic for several reasons. First, it made comparisons between studies difficult, as studies utilised disparate measures, which at times measured different constructs or aspects of pro-environmental attitudes across various response formats. Second, as there is no gold-standard measure, and with the abundance of measures, it is a difficult task for researchers, especially ones new to environmental and conservation psychology, to choose an appropriate measure of pro-environmental attitudes (Hawcroft & Milfont, 2010). It was for these reasons that this study attempted to examine the test-retest reliability, internal consistency, and predictive validity for pro-environmental behaviours of several pro-environmental attitudes measures.

3.1.1 Pro-Environmental Attitudes Measures

In the previous chapter the NEP, ECS, and CNS were discussed in some detail. Thus, these measures will be briefly mentioned here before examining other measures of pro-environmental attitudes. While the NEP was described by some as the best standardised measure to use, until a gold-standard was created, and had good test-retest reliability and internal consistency (Dunlap, 2008; Dunlap et al., 2000; Harraway, Broughton-Ansin, Deaker, Jowett, & Shephard, 2012; Hawcroft & Milfont, 2010; Hedlund-de Witt, 2012), it had been criticised for its psychometric properties. For example, the predictive power of this measure was found to be questionable and despite the original authors of the NEP claiming the measure had several dimensions, evidence for this was lacking (Hedlund-de Witt, 2012). Regarding the ECS, its long term predictive, concurrent, and divergent validity, internal consistency, and test-retest reliability were assessed as being good (Fransson & Gärling, 1999; Schultz, 2001; Weigel & Weigel, 1978). However, the ECS reflected environmental issues that were dominant during the 1970s and 1980s, which had shifted or became dated in

more modern settings due to changing environmental issues (Alcock, 2012; Dunlap & Jones, 2002, 2003; Dunlap et al., 2000). Lastly, amongst the measures of connectedness to nature, the CNS was found to be widely used, and the best in regard to test-retest reliability, internal consistency, and predictive power (Martin & Czellar, 2016; Tam, 2013a). This measure was designed to assess a sense of belonging to nature, on both a cognitive and emotive level (Nisbet et al., 2009). Despite these advantages, some had questioned whether the CNS measured the emotive aspects of pro-environmental attitudes as it was designed to, or if it was more a measure of the cognitive aspects of connecting to nature (Perrin & Benassi, 2009; Tam, 2013a).

There were, however, other measures of pro-environmental attitudes that were not discussed in Chapter 2. Kellert's typologies were developed to reflect humans' relationship with nature, particularly animals, with the items themselves being altered to suit a specific culture or environmental issue (e.g. large carnivores among sheep farmers in Norway; Kaltenborn, Bjerke, & Vittersø, 1999; Rauwald & Moore, 2002). It was developed by Kellert's extensive studies of people's attitudes towards wildlife and nature in general (Butler, Shanahan, & Decker, 2001; Letourneau, 2013; Milfont, 2009; Walton, 2014). The exact number of typologies found varies between studies, but they generally include the typologies of Naturalistic, Ecologistic, Humanistic, Moralistic, Scientistic, Aesthetic, Utilitarian, Dominionistic, and Negativistic attitudes towards nature (Kellert, 1985). Research found that when combined, Kellert's typologies and the NEP provided a greater understanding of pro-environmental policy support (Rauwald & Moore, 2002). A particular advantage of this measure was that it could be tailored towards specific environmental issues (Rauwald & Moore, 2002). It had been argued that measuring specific pro-environmental attitudes would be more likely to predict specific pro-environmental behaviours required to

solve that problem (e.g. measuring recycling attitudes better predicts recycling than general pro-environmental attitudes; St. John et al., 2010).

However, Kellert's typologies were criticised for being methodologically limited, in particular the reliability of measures used to assess these typologies (Manfredo, 2008). Although a strength in some respects, the problem-specific, rather than general, assessment of pro-environmental attitudes, was a limitation as it did not necessarily allow one to measure attitudes towards global environmental issues like global warming or biodiversity loss (Rauwald & Moore, 2002). Furthermore, comparisons between studies, even using the same typology framework, are difficult due to differences in focus (e.g. wolves versus elephants) and subsequently different items within measures.

Although this was a small sampling of measures, it is evident that there is no cohesive way of measuring pro-environmental attitudes. Some measures such as the CNS and the ECS, treat pro-environmental attitudes as unidimensional, while others like Kellert's typologies treat pro-environmental attitudes as multidimensional, with the NEP varying between these two views. Some researchers claim/find that pro-environmental attitudes were unidimensional (Martin & Czellar, 2016; Nisbet et al., 2009; Walton, 2014), while others claim/find they were multidimensional (Maloney & Ward, 1973; Milfont & Duckitt, 2010; Schultz, 2001; Stern & Dietz, 1994). It is clear, even from this sampling of measures, that research is divided on the exact structure of pro-environmental attitudes. One potential solution to this disagreement, was that pro-environmental attitudes were not only horizontally structured, but vertically structured as well (Carman, 1998; Milfont & Duckitt, 2010; Wiseman & Bogner, 2003; Xia & Dunlap, 2007). Despite suggestions for a vertical structure to pro-environmental attitudes, few studies had examined this potential vertical structure (Milfont & Duckitt, 2010). One measure that did though was the EAI (Milfont & Duckitt, 2010).

The EAI was developed by examining existing pro-environmental attitudes measures, as well as creating new items to match newly discovered dimensions (Milfont & Duckitt, 2010). This 120-item measure consisted of 12 subscales, which could be summarised by one or two higher order factors. Although this measure covered a wide range of dimensions and considered the multidimensional nature of pro-environmental attitudes, it had several limitations. First, the length of the measure was an issue, as a large number of items could reduce response rates (Sutton & Gyuris, 2015). This measure could be shortened to a 72- or 24-item version. However, an issue for the 24-item version, was that negatively worded items tended to be the reverse of the positively worded items, rather than entirely different items (Sutton & Gyuris, 2015). This was a problem throughout even the full version of the measure, with most items having a negatively worded counterpart. Although a balance of reverse worded items could reduce acquiescence responding, the fact that the reverse worded items were for the most part the existing items reversed, rather than different items was problematic. This could be problematic, as response rates could be reduced if participants simply think they were being asked the same question multiple times, in both a positive and negative wording (Sutton & Gyuris, 2015). Furthermore, this measure did not incorporate items from two of the most popular measures, which the authors identified in their own paper (Milfont & Duckitt, 2010), the ECS (which was used in our study) and the Ecology Scale (which was not used in our study as it was far too dated).

Although this was but a sampling of the pro-environmental attitudes measures used in the literature, it was clear that there are numerous measures of pro-environmental attitudes with no clear guidance as to which was the most appropriate to use. This was problematic, as mentioned previously, as it hindered comparisons between studies, and made it difficult for researchers to select the most appropriate measure to use. Thus, this formed a motivation for our study, which created a single resource that examined several of the most widely used pro-

environmental attitudes measures, in terms of their test-retest reliability, internal consistency, and predictive validity for pro-environmental behaviours. Another problem with these measures was that they used various response formats, thus, this study examined whether altering response formats had any impact on test-retest reliability and internal consistency.

3.1.2 Present Study

This study primarily aimed to examine the test-retest reliability, internal consistency, and predictive validity for pro-environmental behaviours of several pro-environmental attitudes measures. Secondly, this study aimed to examine the test-retest reliability, internal consistency, and predictive and concurrent validity of the ES, and the concurrent validity of the EB. In doing so, this study aimed to provide a valuable resource for researchers in terms of the psychometric properties of several pro-environmental attitudes measures.

3.2 Study 1 Method

3.2.1 Participants

Participants were recruited from either Prolific (an online recruiting platform) or a first-year undergraduate psychology sample pool at the University of Edinburgh (SONA). Participants recruited via SONA received course credit as compensation for their participation, and participants recruited via Prolific received £5 in compensation for their participation. This sample consisted of 252 participants, 81 recruited via SONA, and the remaining 171 recruited via Prolific. This sample consisted of 123 (48.8%) males, and 129 (51.2%) females, with ages ranging between 16 and 66 (M = 27.54, SD = 10.10).

Data was collected at two time points, with part two consisting of two conditions (Condition A: originally formatted measures and Condition B: homogenised formatted measures). The sample was broken down as such. Condition A consisted of 123 participants (39 from SONA and 84 from Prolific), while Condition B consisted of 129 participants (42

from SONA and 87 from Prolific). Condition A consisted of 59 (48.0%) males, and 64 (52.0%) females, with ages ranging between 16 and 66 (M = 28.53, SD = 10.90). Condition B consisted of 64 (49.6%) males and 65 (50.4%) females, with ages ranging between 17 and 60 (M = 26.60, SD = 9.21).

3.2.2 Measures

3.2.2.1 NEP. The NEP, a 15-item measure, was used (Dunlap et al., 2000). In its original format participants were asked to rate each item on a 7-point Likert response format, with the responses of 1 (*Strongly Disagree*), 2 (*Mildly Disagree*), 3 (*Unsure*), 4 (*Mildly Agree*), and 5 (*Strongly Agree*).

3.2.2.2 CNS. The CNS, a 14-item measure, was used (Mayer & Frantz, 2004). In its original format, participants rated each item on a 5-point Likert response format, with the responses of 1 (*Strongly disagree*), 2 (*Somewhat disagree*), 3 (*Neutral*), 4 (*Somewhat agree*), and 5 (*Strongly agree*).

3.2.2.3 EAI. The EAI, a 120-item measure, was used (Milfont & Duckitt, 2010). In its original format, participants rated each item on a 7-point Likert response format, with the responses of 1 (*Strongly disagree*), 2 (*Disagree*), 3 (*Somewhat disagree*), 4 (*Neither agree nor disagree*), 5 (*Somewhat agree*), 6 (*Agree*), and 7 (*Strongly agree*).

3.2.2.4 ES. The ES developed in Chapter 2 was used. This measure consisted of 58 items, however only 38 items were used, due to a concurrent factor analysis (see A Correction to Chapter 2). In its original format, participants rated each item on a 5-point Likert response format, with the responses of 1 (*Strongly disagree*), 2 (*Somewhat disagree*), 3 (*Neither agree nor disagree*), 4 (*Somewhat agree*), and 5 (*Strongly agree*).

3.2.2.5 Kellert's typologies. The 20-item measure developed by Rauwald and Moore (2002) was used to measure Kellert's typologies. This measure was chosen as Kellert's

typologies were typically modified towards a specific problem, whereas this measure was more generalised. Despite the generalised nature of this measure, a few items referenced specific animals or environments (e.g. Item 1: “Wanting to protect the natural resources and beauty of the Caribbean/United States”). Thus, items 1, 9, and 17 were altered to be more generic rather than referencing a specific animal/environment (e.g. Item 1: “Wanting to protect the natural resources and beauty”). This measure consisted of four typologies: Moralistic/Aesthetic, Dominionistic, Utilitarian, and Humanistic. In its original format, for the Moralistic/Aesthetic questions, participants rated the statements on a 10-point Likert response format, ranging from 1 (*Unimportant*) to 10 (*Very important*). The other typologies, were rated on a 7-point Likert response format, ranging from 1 (*Strongly disagree*) to 7 (*Strongly agree*).

3.2.2.6 ECS. The ECS, a 16-item measure, was used (Weigel & Weigel, 1978). Several items (1, 7, 11, and 15) were edited to remove culturally/environmentally specific language (e.g. Item 11: “Predators such as hawks, crows, skunks, and coyotes which prey on farmer’s grain crops and poultry should be eliminated” was changed to “Predators which prey on farmer’s crops and livestock should be eliminated”). In its original format, participants rated each item on a 5-point Likert response format, with the responses of 1 (*Strongly disagree*), 2 (*Somewhat disagree*), 3 (*Neither agree nor disagree*), 4 (*Somewhat agree*), and 5 (*Strongly agree*).

3.2.2.7 Altering items. We altered some items from the ECS and Kellert’s typologies, to make them more general, rather than culturally/environmentally specific. This means that when these two measures are being assessed, it is these study specific variants that are being assessed. For Kellert’s typologies this is not problematic, as there is no standard measure of Kellert’s typologies. However, this does mean that we are assessing the psychometric properties of this specific variant of the ECS, rather than its original form.

3.2.2.8 Demographic questions. Participants were asked to indicate their gender with the responses of “male”, “female”, and “other”, their age, as well as either their student or Prolific number. Prolific participants were also asked what country they currently resided in.

3.2.2.9 Attention check. Prolific participants had two additional questions included in their survey. The first was embedded in the NEP as an item which stated, “The earth will be uninhabitable within a year”. The second was a question at the very end of the survey that provided participants with a list of behaviours they could choose from. The instructions stated which single behaviour to choose. These questions were used to ensure participants were reading items and questions properly. Participants who failed the behaviour question were given the opportunity to complete the survey once more, if they failed to do this properly their responses were removed. The other attention check was not used as it was ineffective, as participants gave a range of responses, whilst completing the rest of the measures sensibly and passing the other attention check.

3.2.3 Procedure

This study was a two-part experiment approved by the University of Edinburgh Human Research Ethics Committee. Participants completed the survey online via Qualtrics. Participants first provided answers to the demographic questions of student/Prolific number, gender, and age. Furthermore, Prolific participants were asked their country of residence. Participants then completed in a randomised order the pro-environmental attitudes measures; the items within these measures were also presented in a randomised order. Lastly, Prolific participants were presented with the second attention check.

The second part of the study was completed between a week and two weeks after the first part. Participants were randomly allocated (balanced assignment through Qualtrics) to either Condition A or Condition B. Both conditions completed the study in the same manner

as part one. The only difference between conditions, was that in Condition A the original response formats were presented, whereas in Condition B response formats were all reduced to a 5-point Likert scale, with only the anchors of 1 (*Strongly disagree*) and 5 (*Strongly agree*).

3.3 Study 1 Results

3.3.1 Preliminary Analysis

A preliminary analysis was performed in order to ensure that the source of participant recruitment had no impact on any of the pro-environmental attitudes measures. A series of *t*-tests were performed, to test if there were any significant differences between the recruitment sources on any of the pro-environmental attitudes measures. After correcting for multiple comparisons, using a Bonferroni adjustment, critical $\alpha = .002$, there were no significant differences between recruitment sources of any of the pro-environmental attitudes measures, except for the homogenised version of the Humanistic subscale of Kellert's typologies. As a result, a combined sample was used for all subsequent analyses.

As a general guideline, when assessing test-retest reliability and internal consistency, a rule of thumb of $\geq .70$ as good, .69 to .55 as acceptable, and $< .55$ as unacceptable was used.

3.3.2 Test-Retest Reliability

3.3.2.1 Original response format. The test-retest reliability was assessed in order to determine which measure, was the most reliably consistent over time. In order to address this, a series of correlations, with Bonferroni adjustments, critical $\alpha = .002$, were performed, between part one and part two, for participants who completed the measures in their original response formats in both parts. All correlations were significant, $p < .001$. The correlation coefficients for test-retest reliability can be found in Table 1. The NEP had the strongest test-

retest reliability, which demonstrated good test-retest reliability (r = .83). The 120- and 72-item EAI, and the Moralistic/Aesthetic typology also demonstrated good test-retest reliability (r = .70 to .73). The remaining measures demonstrated acceptable reliability (r = .60 to .68), except for the Humanistic and Dominionistic typologies (r = .34 and .49 respectively), which demonstrated unacceptable test-retest reliability.

Table 1. Test-Retest Reliability

Measure	Original Response Format (N = 123)	Homogenised Response Format (N = 129)
	r	*r*
New Environmental/Ecological Paradigm	.83***	.86***
Environmental Attitudes Inventory (120 version)	.73***	.69***
Environmental Attitudes Inventory (72 version)	.72***	.70***
Environmental Attitudes Inventory (24 version)	.68***	.70***
Connectedness to Nature Scale	.60***	.55***
Environmental Concern Scale ǂ	.64***	.70***
Environmentalism Scale	.64***	.66***
Kellert's typologies		
Moralistic/Aesthetic	.70***	.64***
Dominionistic	.49***	.59***
Utilitarian	.61***	.50***
Humanistic	.34***	.65***

Note: ǂ N = 122 for the original response format due to a technical error with the survey
*$p \leq .05$, **$p \leq .002$, ***$p \leq .001$

3.3.2.2 Homogenised response format. This study also examined whether the various pro-environmental attitudes measures could be reduced to a single response format. In order to address this, a series of correlations, with Bonferroni adjustments, critical α = .002, were performed, between part one and part two, for participants who completed the measures in their homogenised response format in part two. All correlations were significant, $p < .001$. Results for these correlations can be found in Table 1. The NEP demonstrated the best test-rest reliability (r = .86). The 72- and 24-item EAI, and ECS demonstrated good test-retest reliability (r = .70). The remaining measures demonstrated acceptable test-rest

reliability (r = .55 to .69), except for the Utilitarian typology (r = .50) which had an unacceptable test-retest reliability.

3.3.3 Test-Retest Comparisons

The reason for attempting to homogenise the pro-environmental attitudes measures' response formats was to determine whether this would impact the measures, as homogenising the measures' response formats would allow for easier comparisons between measures. To assess this *Z*-tests were performed on the test-retest correlations between part one and part two, for Condition A and Condition B. Fisher *Z* transformations were performed. Bonferroni adjustments were made for multiple comparisons, critical $\alpha = .005$. No differences were found for most measures, which suggested that these pro-environmental attitudes measures were relatively robust to changes in response format. However, this robustness was not found for the Humanistic typology, with the test-retest reliability significantly increasing in the homogenised response format. The results of these tests can be found in Table 2.

Table 2. Comparison of Test-Retest Correlations

Measure	*Z*
New Environmental/Ecological Paradigm	-0.82
Environmental Attitudes Inventory (120 version)	0.63
Environmental Attitudes Inventory (72 version)	0.32
Environmental Attitudes Inventory (24 version)	-0.30
Connectedness to Nature Scale	0.59
Environmental Concern Scale	-0.85
Environmentalism Scale	-0.27
Kellert's typologies	
Moralistic/Aesthetic	0.86
Dominionistic	-1.11
Utilitarian	1.25
Humanistic	-3.30***

Note: *$p \leq .05$, **$p \leq .005$, ***$p \leq .001$

3.3.4 Internal Consistency

Lastly, this study examined the internal consistency of the pro-environmental attitudes measures. To do this Cronbach's alphas were calculated for part two Condition A and

Condition B. To examine whether there was a difference between conditions, a Fisher-Bonnet test was used to compare the Cronbach's alphas between Condition A and Condition B. Bonferroni adjustments were made for multiple comparisons, critical α = .005. These can be found in Table 3. In summary there were no differences in internal consistency between the conditions. The EAI and the ES demonstrated the best internal consistency α = .89 to .98. The NEP, CNS, ECS, and the Dominionistic typology all demonstrated good internal consistency (α = .79 to .89). The Moralistic/Aesthetic, Utilitarian, and Humanistic typologies demonstrated acceptable to good internal consistency (α = .56 to .76).

Table 3. Internal Consistency for Pro-Environmental Attitudes Measures

Measure	Cronbach's Alpha		Chi Square
	Part Two Condition A	Part Two Condition B	
New Environmental/Ecological Paradigm	.86	.88	0.65
Environmental Attitudes Inventory (120 version)	.98	.97	4.99*
Environmental Attitudes Inventory (72 version)	.96	.96	0.00
Environmental Attitudes Inventory (24 version)	.90	.89	0.26
Connectedness to Nature Scale	.87	.89	0.75
Environmental Concern Scale	.87	.86	0.15
Environmentalism Scale	.95	.96	1.47
Kellert's typologies			
Moralistic/Aesthetic	.69	.66	0.19
Dominionistic	.79	.80	0.05
Utilitarian	.76	.68	1.83
Humanistic	.56	.65	0.81

Note: *$p \leq .05$, **$p \leq .005$,***$p \leq .001$

This first study assessed the test-retest reliability and internal consistency of pro-environmental attitudes measures. Results demonstrated that, as expected, these measures were reliable and internally consistent, however, the strength of these psychometrics varied between measures. This first study assessed test-retest reliability and internal consistency, but not validity. Thus, a second study was conducted that assessed the validity of these measures.

3.4 Study 2 Method

3.4.1 Participants

Participants were recruited from either Prolific or from SONA at the University of Edinburgh. Participants recruited via SONA received course credit as compensation for their participation, and participants recruited via Prolific received £4 in compensation for their participation. This sample consisted of 255 participants, 110 recruited via SONA, and the remaining 145 recruited via Prolific. This sample consisted of 108 (42.4%) males, 144 (56.5%) females, and 3 (1.2%) "Other"; ages ranged from 16 to 61 (M = 25.93, SD = 9.35); the majority of participants lived in urban areas (212; 83.1%) and 43 (16.9%) lived in rural areas.

3.4.2 Measures

3.4.2.1 Pro-environmental attitudes. This study measured the same six pro-environmental attitudes as measured in Study 1. These six measures used the original formatting and underwent the same alterations as Study 1 (e.g. generalisation of certain items). The NEP (Dunlap et al., 2000) had a Cronbach's alpha of .84. For Kellert's typologies (Rauwald & Moore, 2002), Cronbach's alphas ranged from .61 to .77. The ECS (Weigel & Weigel, 1978) had a Cronbach's alpha of .85. The CNS (Mayer & Frantz, 2004) had a Cronbach's alpha of .86. For the EAI (Milfont & Duckitt, 2010), Cronbach's alphas ranged from .88 to .96. Lastly, the ES had a Cronbach's alpha of .95.

3.4.2.2 PEBS. The PEBS (Markle, 2013), a 19-item measure, that consisted of four subscales (Conservation, Environmental Citizenship, Food, and Transportation), was used. The rating system originally designed by Markle was used, with one exception, that the driving question was given an additional response, "I do not drive" (scored as the most environmental response). In this study Cronbach's alphas ranged from .32 to .87.

3.4.2.3 GEB. The 49-item version of the GEB was used (Kaiser & Wilson, 2000). This measure consisted of eight pro-social behaviours, which were removed from this study for two reasons. Firstly, they did not assess pro-environmental behaviours, and secondly to reduce demands on participants. Participants used a yes/no response format, to indicate their performance of the environmental behaviours presented. An alteration was made for the four items regarding driving, which were asked again after the initial 41 questions adding a third option, "Do not own a vehicle" (scored as the most environmental response). These latter four responses were used instead of the original responses to these items. The Cronbach's alpha for this measure was .76.

3.4.2.4 EB. The EB, a 19-item measure created in Chapter 2, was used. Although this measure consisted of 19-items, only 14 were used due to a concurrent factor analysis (see A Correction to Chapter 2). Participants answered the items on a 5-point Likert response format with the responses of 1 (*Never*), 2 (*Sometimes*), 3 (*About half the time*), 4 (*Most of the time*), and 5 (*Always*). The question regarding car use had the additional option of 6 (*Do not own a car*). This measure had a Cronbach's alpha of .85.

3.4.2.5 Donation to charity. Participants also completed a donation measure (Soutter & Boag, 2019). Participants were presented with brief descriptions of three charities (Oxfam, WWF, and BasicNeeds). After this, they indicated how they would split $100USD spare cash between three charities (WWF being an environmental charity), and the option of spending the money on themselves. Participants were also given the option of explaining why they had split the money the way they did.

3.4.2.6 Demographic questions. Participants were asked to provide either their student or Prolific number, their gender with the responses of "male", "female", and "other",

their age, what country they resided in, and the type of area they lived in for most of the year with the responses of “rural” and “urban”.

3.4.2.7 Attention check. A question was included at the end of the survey that provided participants with a list of behaviours they could choose from. The instructions stated which single behaviour to choose. This question was used to ensure participants were reading items and questions properly. Participants who failed to do this properly had their responses removed. Prolific participants were given a second opportunity to complete the survey if they initially failed this attention check, while SONA participants’ data were simply removed from analysis.

3.4.3 Procedure

This study was approved by the University of Edinburgh Human Research Ethics Committee. Participants completed the survey online via Qualtrics. Firstly, participants provided answers to the demographic questions of student/Prolific number, gender, age, country of residence, and area lived in. Participants then completed in a randomised order the pro-environmental attitudes measures. The pro-environmental behaviours measures were then completed in a randomised order. Lastly, the attention check was administered. The items within the measures, except for the donation measure, were presented in a randomised order.

3.5 Study 2 Results

3.5.1 Preliminary Analysis

The aim of this study was to examine how these pro-environmental attitudes measures were associated with pro-environmental behaviours *per say*, rather than individual pro-environmental behaviours measures (Mõttus, 2016). In order to do this pro-environmental behaviours scores were standardised, and then averaged to create a total pro-environmental behaviours score. Pro-environmental attitudes measures were also standardised. A

preliminary analysis found there was a significant difference between participants recruited via SONA and those recruited via Prolific on their total pro-environmental behaviours score. Thus, the following analyses will present the results of both recruitment sources individually, as well as a combined sample.

Furthermore, due to the multiple measures used, we assessed how frequently there were identical or very similar items between pro-environmental attitudes and behaviours measures. This was to ensure concurrent validity analyses were not inflated by these overlapping items. For pro-environmental attitudes there were 22 identical items. These identical items were all found within the EAI, with 9 taken from the NEP, and 2 taken from the ECS. There were several other items that were similar in ideas. However, a correlation matrix revealed that only one correlation was above .80 (an item which was identically worded in the EAI and ECS). For pro-environmental behaviours there were no identically worded items, but there were 21 items with 7 groups of similar ideas (e.g. “I wait until I have a full load before doing my laundry” and “How often do you wait until you have a full load to use the washing machine or dishwasher”). However, a correlation matrix revealed that there were no correlations between items on different measures above .80. Despite this, it was likely that concurrent validity was inflated when measures shared more of the same items or concepts. Thus, concurrent validity should not be the only marker for a measure’s psychometric properties.

3.5.2 Validity

Correlations between the pro-environmental attitudes measures and the total pro-environmental behaviours score were assessed. The results of these can be found in Table 4. Although the preliminary analysis suggested that there were differences between recruitment sources on total pro-environmental behaviours scores, this had little to no impact on the interpretation of validity. With no significant differences in correlations between recruitment

sources ($p > .050$) on any pro-environmental attitudes measure. Thus, only the combined sample will be discussed in detail.

Table 4. Correlations between Pro-Environmental Attitudes and Behaviours

Measure	Total Behaviours Score		
	Combined ($N = 255$)	SONA ($N = 110$)	Prolific ($N = 145$)
New Environmental/Ecological Paradigm	.41	.41	.41
Environmental Attitudes Inventory (120 version)	.57	.55	.60
Environmental Attitudes Inventory (72 version)	.56	.54	.59
Environmental Attitudes Inventory (24 version)	.57	.55	.58
Connectedness to Nature Scale	.49	.47	.54
Environmental Concern Scale	.57	.50	.58
Environmentalism Scale	.56	.54	.56
Kellert's typologies			
Moralistic/Aesthetic	.33	.30	.43
Dominionistic	-.37	-.32	-.37
Utilitarian	-.50	-.54	-.48
Humanistic	.29	.29	.33

Note: For all correlations $p < .0001$

For the combined sample the EAI (all versions), ECS, and ES had the strongest associations with pro-environmental behaviours ($r = .56$ to .57). The CNS and Utilitarian typology had the next strongest associations ($r = .49$ and -.50 respectively). The NEP, and the Moralistic/Aesthetic and Humanistic typologies were positively associated with pro-environmental behaviours ($r = .29$ to .41) and the Dominionistic typology was negatively associated with pro-environmental behaviours ($r = -.37$).

3.5.2.1 Concurrent Validity

The concurrent validity of the newly established measures were also assessed. It was found that the ES was moderately to strongly associated with other pro-environmental attitudes measures ($r = .40$ to .83, $p < .001$; in the combined sample). This indicated that the ES demonstrated concurrent validity with existing measures of pro-environmental attitudes. The EB correlated with a total pro-environmental behaviours score (an average of the

standardised GEB, PEBS, and donation to charity measures) strongly (r = .66, p < .001, in the combined sample). This indicated that the EB demonstrated concurrent validity with existing measures of pro-environmental behaviours.

3.6 Discussion

3.6.1 Test-Retest Reliability and Internal Consistency

We aimed to examine the test-retest reliability and internal consistency of several pro-environmental attitudes measures. Our first study addressed this aim and examined the test-rest reliability, internal consistency, and ability to alter response formats for several existing pro-environmental attitudes measures. Results demonstrated that these measures were reliable and internally consistent. However, the level of reliability and internal consistency varied between measures.

For test-retest reliability, the NEP performed the best of the measures we examined, across both response formats. The remaining measures demonstrated acceptable to good test-retest reliability. However, there were three exceptions to this, these exceptions being the Utilitarian, Dominionistic, and Humanistic typologies. The Dominionistic and Humanistic typologies demonstrated unacceptable test-retest reliability when examined in their original format, but not in their homogenised format. The Utilitarian typology demonstrated unacceptable test-retest reliability when examined in its homogenised format, but not in its original format. Despite these differences only the Humanistic typology demonstrated a significant difference in its test-retest reliability between its original and homogenised format. These issues could be explained by several reasons. Firstly, the items assessing these typologies were not from an established measure, but rather were created for a specific study (Rauwald & Moore, 2002). However, this was not an issue for the Moralistic/Aesthetic typology. Furthermore, there are no established measures of Kellert's typologies with items always being created for a specific study (Rauwald & Moore, 2002). Another, potential

reason for these issues was that Kellert's typologies suffer methodologically, specifically in terms of their reliability (Manfredo, 2008), which this study demonstrated.

Lastly, regarding internal consistency the EAI (all versions) and the ES demonstrated the highest internal consistencies. The NEP, CNS, ECS, and Dominionistic and Utilitarian typologies, all demonstrated good internal consistency. Lastly, the Moralistic/Aesthetic and Humanistic typologies demonstrated acceptable internal consistency. There were no differences between response formats, which indicated that these small changes in response formats did not alter internal consistency. The underperformance in internal consistency of the Moralistic/Aesthetic and Humanistic typologies supported the idea that Kellert's typologies suffer methodologically (Manfredo, 2008). However, one must keep in mind that internal consistency assesses whether the items in a measure examine a single cohesive idea. Although this indeed could be a psychometric advantage, one must not decide how useful a measure is purely on this psychometric property. Thus, a measure should not be rejected purely due to low internal consistency or chosen purely due to high internal consistency.

Another important comment to make regarding internal consistency, is the limitations of Cronbach's alphas. It was found that the EAI and ES had consistently high scores on this metric, which were above .90. However, the EAI and ES were also the longest measures of pro-environmental attitudes. Even the shortest of these measures, the 24-item EAI, was 8 items longer than the next longest measure the ECS (16 items). Cronbach's alpha is susceptible to inflation when there are a greater number of items within a measure, regardless of the consistency between items (Agbo, 2010). This again reiterates the point above that internal consistency should not be the primary factor for choosing or not choosing a measure. Alternative forms of internal consistency should be used in future studies such as the use of omega (Revelle & Zinbarg, 2009). This, however, would require a larger sample size to accurately ascertain.

The examination of all three versions of the EAI allowed a comparison in the test-retest reliability and internal consistency of each version. It appeared that all versions of the EAI were similarly reliable in regard to test-retest reliability, resilience to small changes in response format, and internally consistency. This was beneficial as it suggested that the shortest version might be as psychometrically sound as the longest version.

3.6.2 Validity

Another aim was to examine the predictive validity for pro-environmental behaviours of several pro-environmental attitudes measures. Our second study addressed this and examined how well several pro-environmental attitudes measures were associated with pro-environmental behaviours. The results demonstrated that, these pro-environmental attitudes measures were associated with pro-environmental behaviours, which suggested predictive validity. However, the strength of these associations varied between pro-environmental attitudes measures. The EAI (all versions), ECS, ES, CNS, and Utilitarian typologies had the strongest associations with pro-environmental behaviours. The NEP was associated with pro-environmental behaviours, but to a lesser extent, as too were the Moralistic/Aesthetic, Dominionistic, and Humanistic typologies. Thus, the EAI (all versions), ECS, ES, CNS, and Utilitarian typologies had the strongest predictive validity for pro-environmental behaviours. The examination of all three versions of the EAI allowed a comparison in the associative ability of each version. All versions of the EAI held their associations with pro-environmental behaviours, with no noticeable drop between versions. This was beneficial as it suggested that the shortest version may be as good as the longest version at predicting pro-environmental behaviours. However, it is important to note that we looked at associations, not predictions, here.

3.6.3 New Measures

In Chapter 2, two new measures, the ES and EB, were developed, which were further assessed in this chapter. An important question to answer was whether these measures were psychometrically good, and if so, did they provide additional or better value than that of existing measures.

Regarding the ES, in Chapter 2 there was some preliminary evidence that the ES was moderately to strongly associated with pro-environmental behaviours, indicating predictive validity. In this chapter the psychometric properties were further assessed. It was found that this measure had acceptable test-retest reliability, strong internal consistency, and was robust to changes in response format. These psychometric properties were on par with existing measures of pro-environmental attitudes. Furthermore, this measure had one of the strongest associations with pro-environmental behaviours, which suggested that this measure also had good predictive validity. Lastly, it demonstrated good concurrent validity with existing measures of pro-environmental attitudes. These findings suggest that the ES is a valuable measure of pro-environmental attitudes and performs as well as existing measures of pro-environmental attitudes. However, in no metric was the ES better than all existing measures, with the EAI either outperforming or performing on par with the ES. Thus, while our new measure indeed has value, and was amongst the strongest to be associated with pro-environmental behaviours, there is no evidence to suggest that it is better than all existing measures of pro-environmental attitudes.

Regarding the EB, in Chapter 2 there was some preliminary evidence that it was associated with the GEB, suggesting concurrent validity. This was expanded upon in this chapter where it was found, to be strongly associated with a wide range of existing measures of pro-environmental behaviours. This again demonstrated that the EB had concurrent validity. The EB was designed to be a general measure of pro-environmental behaviours, and

thus it should be compared to the existing general measures of pro-environmental behaviours, the GEB and PEBS. Examining the items assessed between these three measures showed that there was some overlap between items. For example, all three asked about eating organic food/vegetables, and membership to environmental organisations. However, the EB measured some pro-environmental behaviours that were not covered by these two existing measures, such as political action. Thus, while the EB assessed items covered by existing measures, it also assessed items that were not. However, the same is true for the GEB and PEBS, which assessed behaviours not covered by the EB. Lastly, the EB is limited in that it assessed general pro-environmental behaviours, rather than a specific subset of behaviours. Thus, the utility of this measure for specific pro-environmental behaviours, is limited, and a more specialised measure would best be suited for research questions examining specific behaviours.

Generally speaking, both the ES and EB were shown to have value and be good measures of pro-environmental attitudes and behaviours respectively. While they do have their advantages, they are not necessarily better than other existing measures. We suggest that future research that is interested broadly in pro-environmental attitudes and behaviours should use these new measures in combination with other existing measures, to create a more holistic picture of pro-environmental attitudes and behaviours.

3.6.4 Limitations

There were several limitations that need to be considered. Firstly, all measures examined here were self-report. This was potentially problematic for pro-environmental behaviours as there was no measure of objective actual pro-environmental behaviours (Lange & Dewitte, 2019). The hypothetical donation scenario attempted to breach the gap between self-report and actual pro-environmental behaviours; however, it was still self-report. Although this was problematic, a great deal of research in this area uses self-reports for

measurements of pro-environmental behaviours (Lange & Dewitte, 2019; Steg & Vlek, 2009). Furthermore, the use of self-reports allowed for an easy examination of pro-environmental attitudes' associations with pro-environmental behaviours. Future research should examine objective actual pro-environmental behaviours, to ascertain whether the associative patterns found within this study hold for non-self-report measures.

Another limitation was that in the first study, due to time and sample size constraints, only one homogenised response format was tested. We opted for a 5-point Likert response format with only the anchors of "Strongly disagree" and "Strongly agree". As a result, we were not able to test the impact of multiple Likert response formats. It might be the case that there were more optimal Likert response formats. Another issue, that impacted both studies, was that due to time and sample size constraints, we were limited in the pro-environmental attitudes and behaviours measures we could examine. Although several measures were included, this was by no means an exhaustive list. Future research should examine the impact of using different Likert response formats (e.g. 7-point and 10-point), across a variety of different pro-environmental attitudes and behaviours measures.

Despite these limitations, this study was one of the first to create a single source for testing the test-retest reliability, internal consistency, and predictive validity for pro-environmental behaviours of several pro-environmental attitudes measures. Although the reliability and validity of these pro-environmental attitudes measures was assessed in past research, this was done in different samples, by different researchers. This study assessed the test-retest reliability and internal consistency of these pro-environmental attitudes measures in one set of participants, and the predictive validity of these measures in another set of participants. This allowed for an easy comparison between measures on their test-retest reliability, internal consistency, and predictive validity, as sample differences were controlled for.

3.7 Conclusion

In conclusion, this study examined the reliability, internal consistency, and predictive validity for pro-environmental behaviours of several pro-environmental attitudes measures. It was found that the NEP had the best test-retest reliability, strong robustness to changes in response format, and good internal consistency. However, its association with pro-environmental behaviours was limited. The CNS, EAI, ECS, and ES had acceptable to good test-retest reliability, good internal consistency, strong robustness to changes in response format, and strong associations with pro-environmental behaviours. This study demonstrated that the newly established ES had acceptable to good test-retest reliability, internal consistency, strongly associated with pro-environmental behaviours, and demonstrated concurrent validity. Lastly, the newly established EB demonstrated concurrent validity.

Part 2: On Personality and Pro-Environmental Attitudes and Behaviours

In Part 1 of this dissertation the psychometric properties of several pro-environmental attitudes measures were assessed. Doing so allowed an informed decision to be made regarding which measure(s) should be used to assess how individual differences were associated with pro-environmental attitudes and behaviours.

As discussed in Chapter 1, personality, an aspect of individual differences, is likely to be a powerful and ubiquitous antecedent for differences in pro-environmental attitudes and behaviours (Karbalaei et al., 2014). The examination of personality's associations with pro-environmental attitudes and behaviours stretches back to the beginning of environmental and conservation psychology. However, only recently has research focused on how broad constructs of personality, like the Big Five or HEXACO, were associated with pro-environmental attitudes and behaviours (Markowitz et al., 2012; Milfont & Sibley, 2012).

The following chapters examined how these broader personality traits were associated with pro-environmental attitudes and behaviours. In Chapter 4, a systematic review of the literature was performed, which examined how the Big Five and HEXACO were associated with pro-environmental attitudes and behaviours. With this, a meta-analysis was conducted and determined which personality domains were associated with pro-environmental attitudes and behaviours. Furthermore, the ability of these domain-level associations, collectively, to predict pro-environmental attitudes and behaviours, was assessed. Chapter 5 expanded on this and provided a narrower (i.e. facet-level) examination of how personality traits were associated with pro-environmental attitudes and behaviours. This was done for two reasons. Firstly, to understand whether facet-level information provided a greater understanding of the associations between personality and pro-environmental attitudes and behaviours. Secondly, it assessed whether this greater information improved the ability to predict pro-environmental attitudes and behaviours from personality traits.

Chapter 4: Big Five and HEXACO Personality Traits, and Pro-Environmental Attitudes and Behaviours: A Meta-Analysis

4.1 Chapter Introduction

As mentioned in Chapter 1 personality assesses an individual's characteristic patterns of thoughts, feelings, and behaviours (American Psychological Association, 2020). Although identified in early research as an avenue for understanding pro-environmental attitudes and behaviours, research historically focused on narrowly constructed personality traits (Markowitz et al., 2012; Milfont & Sibley, 2012). However, there had been an increasing interest into how broader constructs of personality were associated with pro-environmental attitudes and behaviours.

As mentioned in Chapter 1 it was suggested that studying these broader constructs of personality would be beneficial for three key reasons (Markowitz et al., 2012). That 1) these broad domain constructs represented basic stable patterns of individual differences, and could be used to predict behaviours; 2) if pro-environmental attitudes and behaviours were at least partially derived from stable individual differences, broad domain constructs were likely to partially explain differences between individuals' pro-environmental attitudes and behaviours; and 3) examining these highly stable constructs may provide a more reliable understanding of differences in individuals' pro-environmental attitudes and behaviours than social psychological variables. Although in its infancy, research had examined broader constructs of personality. Most notable amongst this research, were the studies that examined the domains found within the Big Five and HEXACO models of personality. These hierarchical models of personality consist of five domains, Neuroticism, Extraversion, Openness, Conscientiousness, and Agreeableness, with the HEXACO adding a sixth domain Honesty-Humility (Ashton & Lee, 2007; Goldberg, 1990; McCrae & John, 1992).

Over the past two decades there had been a growing body of research that examined how the Big Five and HEXACO domains were associated with pro-environmental attitudes and behaviours. Among these domains, Openness was found to be the most consistently

associated with pro-environmental attitudes and behaviours (Brick & Lewis, 2016; Hirsh & Dolderman, 2007; Markowitz et al., 2012; Nisbet et al., 2009; Soliño & Farizo, 2014). Agreeableness was found to be generally associated with pro-environmental attitudes and behaviours (Hirsh, 2010; Hirsh & Dolderman, 2007; Nisbet et al., 2009), although some research suggested a limit to these associations (Lee et al., 2015; Markowitz et al., 2012). Although the HEXACO had received less attention, Honesty-Humility was associated with pro-environmental attitudes and behaviours, but with some limitations to the generalisability of this (Brick & Lewis, 2016; Hilbig et al., 2013; Lee et al., 2015; Markowitz et al., 2012; Milfont et al., 2015). Conscientiousness, Extraversion, and Neuroticism had been less consistently associated with pro-environmental attitudes and behaviours (Brick & Lewis, 2016; Hirsh, 2014; Kvasova, 2015; Markowitz et al., 2012; Milfont & Sibley, 2012; Lee et al., 2015).

Despite the growing body of research in this area, and the apparent inconsistency between studies on exactly what domains were associated with pro-environmental attitudes and behaviours, there had been no systematic assessment of the literature on this topic. Furthermore, knowing which aspects of personality were robustly associated with pro-environmental attitudes and behaviours, might allow policymakers to design more effective policies and interventions, by designing them to target specific barriers to desired outcomes. For example, if Openness was robustly associated with pro-environmental attitudes and behaviours, effective interventions could focus on simple and effective cognitive and behavioural strategies that were already established, instead of framing the desired behaviour as a moral imperative or novel. This would be effective because individuals who are high in Openness would be likely to be already engaging in these desired behaviours, and those low in Openness would be unlikely to be swayed by these latter message framings. For these

reasons we performed a meta-analysis that assessed the associations between the personality domains of the Big Five and HEXACO, and pro-environmental attitudes and behaviours.

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Big Five and HEXACO Personality Traits, Proenvironmental Attitudes, and Behaviors: A Meta-Analysis

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Abstract

With climate change and its consequences believed to be among the most vital challenges for humanity and the Earth's ecosystem, it is important to understand why individuals do or do not adopt proenvironmental attitudes and behaviors. Personality traits are well suited for this purpose. Because no recent work has systematically combined the accumulating evidence on this topic, we aimed to meta-analyze the associations of the Big Five and HEXACO personality domains with proenvironmental attitudes and behaviors. A meta-analysis of 38 sources (N = 44,993) implicated openness and honesty-humility as the strongest correlates of proenvironmental attitudes (r = .22 and .20) and behaviors (r = .21 and .25). Agreeableness, conscientiousness, and, to a lesser extent, extraversion were also associated with proenvironmental attitudes (r = .15, .12, and .09) and behaviors (r = .10, .11, and .10). Heterogeneity among effect sizes was partly explained by samples' gender ratio, age, and country of origin and by the personality model. *P*-curve analyses, funnel plots, and Egger's tests indicated significant but sporadic and small publication bias. As a validity test, the meta-analytic associations collectively provided substantial predictive accuracy for proenvironmental attitudes (r = .44–.45) and behaviors (r = .28–.43) in independent holdout samples.

Keywords

Big Five, HEXACO, environment, attitude, behavior

Climate change is increasingly accepted as one of the most—if not *the* most—important global challenge (Hilbig, Zettler, Moshagen, & Heydasch, 2013; Nisbet, Zelenski, & Murphy, 2009; Otto, Kaiser, & Arnold, 2014; Poškus & Žukauskienė, 2017). Consensus reports suggest drastic changes to Earth's ecosystems (e.g., Intergovernmental Panel on Climate Change, 2018; Klein, Hilbig, & Heck, 2017; United Nations Environment Programme, 2019), such as large (0.7–1.2 m) rises in sea levels by the end of the 21st century (Horton, Rahmstorf, Engelhart, & Kemp, 2014). Although climate change is a universal problem, attitudes and behaviors linked to it and its avoidance differ widely among people and groups (e.g., Crippa et al., 2019; Schmidt, Krauth, & Wagner, 2017). Nonpsychological factors such as wealth, urbanization, household size, and age can explain some of the differences (e.g., Cole & Neumayer, 2004; Dietz & Rosa, 1997; Shi, 2003); for example, wealthier people can consume more and thereby have a larger environmental footprint. However, there may also be psychological reasons for why we, as a species, have pursued and continue to pursue behaviors that contribute to climate change.

Psychological Correlates of Proenvironmental Attitudes and Behavior

Proenvironmental attitudes can be defined as one's tendency to exhibit a degree of favor toward the natural environment (e.g., one's connection to nature, defining one's self as an environmentalist, environmental awareness, intention to recycle). *Proenvironmental behaviors* can be described as concrete actions (including the behavior of not taking an action), whether deliberate or not, that positively affect the natural environment (e.g., recycling, purchasing organic products, water or energy

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reduction; Lange & Dewitte, 2019). There is a robust empirical link between such attitudes and behaviors (Bamberg & Möser, 2007; Klöckner, 2013), with a typical correlation just under .40 (Hines, Hungerford, & Tomera, 1987). An association of proenvironmental attitudes with proenvironmental behaviors is in accordance with multiple psychological models that postulate a link between attitudes and behaviors (e.g., Theory of Planned Behavior; de Leeuw, Valois, Ajzen, & Schmidt, 2015; Value-Belief-Norm model; Kaiser, Hübner, & Bogner, 2005). Attitudes, however, are not the only psychological antecedents of proenvironmental behaviors.

A wealth of research has examined social and psychological factors that could influence proenvironmental behaviors, either via attitudes or directly (Hilbig et al., 2013; Hirsh, 2010). In the first meta-analysis on this topic (Hines et al., 1987), a number of psychosocial variables were associated with proenvironmental behaviors, including not only proenvironmental attitudes (r = .35) but also locus of control (r = .37), personal responsibility (r = .33), economic orientation (r = .16), and verbal commitment (r = .49), all values corrected for sampling and instrument variability. A second meta-analysis, undertaken 20 years later (Bamberg & Möser, 2007), replicated the association of proenvironmental behaviors with proenvironmental attitudes (r = .42) and reported associations with perceived behavioral control (r = .30), internal attribution (r = .24), and intention to act (r = .52). Other factors associated with proenvironmental behaviors included problem awareness (r = .19), adherence to social (r = .31) and moral norms (r = .39), and generalized feelings of guilt (r = .30).

Personality Traits and Proenvironmental Attitudes and Behaviors

That psychological characteristics, such as feeling in control, internal attribution, adherence to social norms, and feeling guilty, are associated with proenvironmental behaviors suggests potential links between personality and proenvironmental attitudes and behaviors. Personality, defined as "the characteristic pattern of thoughts, feelings, and behaviors exhibited by individuals" (American Psychological Association, 2019), forms a core part of one's motivations, beliefs, values, and attitudes and is therefore likely to be a powerful and ubiquitous antecedent for differences in individuals' proenvironmental attitudes and behaviors (Karbalaei, Abdollahi, Momtaz, & Talib, 2014). For example, an individual's impact on the environment typically involves a variety of behaviors enacted across a wide range of situations and repeated over extended periods of time (Markowitz, Goldberg, Ashton, & Lee, 2012); this patterning of behavior is what personality research examines. Less commonly but perhaps of equal importance, the personality traits and associated attitudes of a few powerful individuals may have substantial and lasting effects on climate policies.

In addition to the few personality characteristics considered in these earlier meta-analyses, researchers have started to link proenvironmental attitudes and behaviors with a wider range of personality traits (Hirsh, 2010, 2014; Klein, Heck, Reese, & Hilbig, 2019; Markowitz et al., 2012; Milfont & Sibley, 2012), often assessed using the five-factor model (McCrae & John, 1992), or the Big Five (Goldberg, 1990), which use five broad domains: emotional stability (neuroticism), extraversion, openness, agreeableness, and conscientiousness. We refer to these domains as the Big Five throughout. The six-factor HEXACO personality-trait model (Ashton & Lee, 2007) is also increasingly being used; this model adds the honesty-humility domain to the Big Five (which is related to agreeableness and conscientiousness in the Big Five; Lee, Ashton, Choi, & Zachariassen, 2015). HEXACO extraversion, conscientiousness, and openness are very similar to their equivalents in the Big Five (Lee et al., 2015), whereas agreeableness and emotionality slightly differ from their Big Five counterparts (Ashton, Lee, & de Vries, 2014; Lee et al., 2015).

Among the Big Five and HEXACO domains, openness has been reported to have the most systematic correlation with proenvironmental attitudes and behaviors (Brick & Lewis, 2016; Hirsh & Dolderman, 2007; Markowitz et al., 2012; Nisbet et al., 2009; Soliño & Farizo, 2014). Results for the other personality domains have been less consistent (Brick & Lewis, 2016; Hirsh, 2014; Kvasova, 2015; Lee et al., 2015; Markowitz et al., 2012; Milfont & Sibley, 2012). So far, however, no comprehensive meta-analysis has been conducted on these associations despite the fact that the meta-analysis is one of the best tools psychologists can use to synthesize and present research findings (Maki, Cohen, & Vandenbergh, 2018). The earlier meta-analyses (Bamberg & Möser, 2007; Hines et al., 1987) focused only on selected specific personality traits such as locus of control, personal responsibility, feelings of guilt, and economic orientation. They did not address traits commonly used in current personality research such as the domains of the Big Five and HEXACO.

Possible Implications of Personality Traits

A global issue such as climate change, for which policymakers may propose large-scale interventions such as rewarding proenvironmental behaviors, requires a strong evidence base. Policymakers are therefore increasingly looking toward the social sciences for strategies to combat environmental issues (Maki et al., 2018). An understanding of the psychological factors

related to proenvironmental attitudes and, ultimately, behaviors, may allow policymakers to design more effective policy and interventions that target specific barriers to desired outcomes. Among other applications, such knowledge can help to target more specific population subgroups or frame proenvironmental interventions in ways that accommodate the domains of those who are otherwise the least likely to behave in desired ways.

For example, low openness is reflective of a relatively smaller and less flexible repertoire of cognitive and behavioral strategies. Therefore, if low openness is a barrier to proenvironmental behavior, effective interventions may focus on facilitating the adoption of new, more environmentally friendly cognitive and behavioral strategies and lowering the barrier to modifying people's behavioral repertoires rather than trying to frame the desired behavior as a moral imperative. If domains such as low agreeableness and honesty-humility are involved, interventions framing desired behaviors as being morally and socially justified may not be effective because individuals with low scores on measurements of these domains may be less likely to care about these attributes. Instead, strategies highlighting ways in which it is personally profitable to change behavior, at least in the long run, may be more effective. If low conscientiousness appears to be a barrier to proenvironmental behavior, interventions may focus on making desired behaviors easier to enact; again, tapping into people's sense of duty, characteristic of high conscientiousness, may prove less effective.

The associations of personality traits with proenvironmental attitudes and behaviors are also theoretically important. For example, they can hint at the degree to which these outcomes are tied to more temperamental characteristics of individuals as opposed to extrinsic factors. Of course, even if these attitudes and behaviors can, to a substantial degree, be explained by personality traits, this does not mean that they are immutable. Rather, these associations with personality traits may point to underlying motives that support and sustain existing attitudes and behaviors, as well as suggest ways to improve the effectiveness of communication of intended messages, thereby using people's personality traits to help guide their behavior rather than changing the traits. More abstractly, knowing the domains of life in which personality plays out helps us to better understand the consequences of personality.

Current Study

Given the value of knowing how basic personality traits are linked with proenvironmental attitudes, and ultimately behavior, combined with the current paucity of integrative research efforts to this effect, we carried out a comprehensive meta-analysis on this topic. Routinely relying on meta-analytic databases and dynamically updating them can help social scientists to best summarize and communicate the state of research to policymakers (Maki et al., 2018). In collating available findings on the associations between the Big Five and HEXACO personality domains with proenvironmental attitudes and behaviors, we expected the strongest associations for openness; somewhat weaker associations for agreeableness, honesty-humility, and conscientiousness; and no consistent associations for extraversion or neuroticism. Because associations of personality traits with proenvironmental behaviors are at least partly mediated by proenvironmental attitudes, we expected the personality correlates of the latter to be similar to the former in configuration but stronger in magnitude. This is because attitudes are more proximal to personality traits than behaviors in the case of such mediation.

Method

Literature search

A literature search of quantitative associations of personality domains with proenvironmental attitudes and behaviors was conducted. Studies were located using the electronic databases PsycINFO, PsycARTICLES, and Web of Science Core Collection. The search terms are shown in Table 1. All personality terms were entered with the Boolean operator OR. The terms pertaining to proenvironmental attitudes and behaviors were also combined with OR. The personality terms were combined with the environmental terms with the Boolean operator AND. For PsycINFO the options of "English language" and "all articles" were selected. Likewise, the options of "articles" and "English" were selected for the Web of Science Core Collection. Furthermore, the environmental terms were enclosed in quotes to keep the term as one. PsycARTICLES does not provide options for language or type of resource. The search consisted of all articles indexed during a search conducted on May 31, 2019.

This database search was supplemented by a search using Google Scholar. A reduced number of terms were used for this search because Google Scholar does not have the advanced search functionality that other databases do in relation to combining multiple search terms. We used the search phrase "personality AND environmental behaviour OR environmental behavior OR environmental attitude." The Google Scholar search was also conducted on May 31, 2019. Only the first 20 pages were used as part of this literature search, as subsequent results were not deemed relevant. Last, any references to other potentially relevant sources in the articles included by

Table 1. Search Terms Used in Database Searches

Personality terms	Environmental terms
5 factor model	Environmental attitude*
5 FM	Green attitude*
5FM	Sustainable attitude*
Agreeableness	Ecological attitude*
Big 5	Environmental behavio*
Big Five	Green behavio*
Conscientiousness	Sustainable behavio*
Extraversion	Ecological behavio*
FFM	
Five Factor Model	
NEO	
Neuroticism	
OCEAN	
Openness	
Personality	
HEXACO	
Honesty	
Honesty-Humility	
Honesty and Humility	
Emotionality	

the previously described methods were examined, and this was repeated for any other articles that were discovered in this manner. Finally, data from A. R. B. Soutter's Master's degree research were incorporated (Soutter, 2015).

Inclusion and exclusion criteria and coding rules

Several inclusion criteria were applied when reading the abstract, method, and results sections of the articles identified in the literature search. First, only journal articles or unpublished manuscripts were retained, which excluded books. This was done to ensure sources were predominantly peer-reviewed and because books are often not available online. Second, all sources must have been empirical studies; theoretical or review articles were not included. This was done because the quantitative data that are required for a meta-analysis cannot be extracted from these latter types of articles. Third, all studies needed to measure at least one personality domain from the Big Five or the HEXACO model and at least one measure of proenvironmental attitude or proenvironmental behavior. This inclusion criterion meant that we excluded articles using traits named similarly to the Big Five or HEXACO domains (e.g., extraversion) that were not measured using a Big Five or HEXACO instrument per se. For example, Wiseman and Bogner (2003) examined extraversion and neuroticism using the Eysenck personality model. Similar examples include Borden and Francis (1978) and Ray (1980).

Furthermore, dietary habits (i.e., veganism and vegetarianism) alone were not included as a proenvironmental attitude or behavior because of their potential ambiguity with respect to environmentalism. Although dietary habits were a part of several scales of proenvironmental behavior (e.g., Brick & Lewis, 2016), these habits were included only if they were part of a greater set of proenvironmental constructs. A proenvironmental attitude was operationalized as any measure that examined valuations of, or intentions to act on, any explicitly environmental issue (excluding veganism/vegetarianism not otherwise elaborated). A proenvironmental behavior was operationalized as any measure that examined actual actions (not intention), whether self-reported or observed independently. A full list of the attitude and behavior measures can be found on the Open Science Framework at https://osf.io/jky45. Fourth, the analyses had to be conducted at the individual level and not community or national level. Finally, studies were included only if they reported correlation coefficients for associations between personality and environmental attitudes and/or behaviors. For those articles that did not include correlation coefficients ($k = 37$), the first/corresponding author was contacted to request the correlations. Ten of these authors provided useable correlations.

Effect sizes

Pearson product-moment correlations were used as the effect sizes but were transformed via Fisher's r-to-Z transformation for analysis (Hedges & Olkin, 1985).

Coding

A Pearson product-moment correlation coefficient was extracted (or requested from authors) from each source as well as the sample size on which the correlation was based; standard errors for the correlations were calculated according to the standard formula based on effect and sample sizes. The personality model (Big Five or HEXACO) used to assess personality and the measure used to assess attitudes or behaviors were recorded. Where possible, the mean age and its standard deviation, percentage of women, country of origin, and educational level (coding copied from respective studies and thus no consistent coding) of participants were recorded. Country of origin was grouped into Northern America, Asia, Europe, Australia and New Zealand, and "mixed" on the basis of geographic region. Russia and Turkey were ambiguous, existing territorially on both the Asian and European continents. For this study both were coded as European countries. All coding was conducted by A. R. B. Soutter.

Statistical analyses

Initial coding was completed in Microsoft Excel, and the data were imported into RStudio (Version 3.5.0; RStudio Team, 2015). Calculations of standard error and Fisher's *r*-to-*Z* transformations were conducted first. Meta-analyses were conducted using the *metafor* package (Viechtbauer, 2019). Meta-analyses were conducted to examine the association between each of the Big Five and HEXACO's domains and proenvironmental attitudes and behaviors separately using the rma.uni() function of *metafor*. Put simply, a meta-analysis combines the results of multiple studies to create a pooled effect. This involves weighting individual effect sizes by their precision (i.e., standard error), which in turn reflects factors such as measurement precision and sample size. The nonindependence of multiple indicators from the same study can also be taken into account. For a more thorough understanding see Borenstein, Hedges, Higgins, and Rothstein (2011). Forest plots were used to depict effect sizes of individual studies (see the Supplemental Material available online). Evidence of publication bias was examined using multiple indicators: funnel plots in the first instance, Egger's test for asymmetry, and *p*-curve analyses using *p*-curve function (Version 4.06; Simonsohn, Nelson, & Simmons, 2017). Further exploratory analysis testing for potential moderation was conducted using the rma.uni() function of the metafor package, with bootstrapped confidence intervals using 10,000 iterations.

The ultimate indication of the predictive power of personality traits is their usefulness in predicting yet unmade observations about the outcome of interest. We tested this using ideas from machine learning. Briefly, Yarkoni and Westfall (2017) argue that, to date, psychological models have been valued more by their ability to explain the same data in which the models are fitted rather than their ability to predict beyond these data. But because any data set and models fitted therein contain a combination of true associations, sampling error, and idiosyncrasies related to researchers' methodological and analytical choices (researcher degrees of freedom), psychological models tend to be overfit to particular sets of data. Because these models can mistakenly interpret sample-specific and methodology-specific idiosyncrasies as true associations, these models may perform poorly in new data with different idiosyncrasies. To mitigate this possibility, Yarkoni and Westfall suggest using elements from machine learning. This can be done by performing an initial analysis to "train" a model in one data set and subsequently testing the performance of this model to predict associations in another holdout data set.

In the current study, this approach was implemented by first performing the meta-analysis, as described above, and subsequently using the meta-analytically derived associations of personality traits to predict proenvironmental attitudes and behaviors in holdout data sets not included in the meta-analysis. This was done by multiplying standardized personality scores in the holdout data sets by meta-analytic regression coefficients to create predicted (from personality traits) attitude and behavior scores. In the holdout data sets the proenvironmental attitude scales were standardized and averaged to create an overall proenvironmental attitude score; this was similarly done for proenvironmental behaviors. The predicted attitude and behavior scores were then correlated with measured attitude and behavior scores in these holdout data sets, quantifying how well personality traits predicted attitudes and behavior, free of possibly distorting effects of sampling bias and methodological quirks of particular studies (the meta-analysis relied on a diverse set of measures for each construct and the holdout sample used another set). Among other positive aspects of these analyses, this helps to satisfy the assumption that statistical associations are independent of a particular measure used to test them (Mõttus, 2016) and controls for the overlaps among the predictors, which may unduly inflate their bivariate associations with the outcomes.

Results

Data and analysis

The data used in this study and the code used to generate the results can be found on the Open Science Framework at https://osf.io/jky45.

Literature overview

A total of 58 relevant journal articles and one unpublished PhD dissertation were found in the literature search. Of these, 22 journal articles were rejected either because (a) the required correlations did not exist and were not provided by authors or (b) the data had also been used in another study already included in the meta-analysis. In the latter case, results from the study with the larger sample size were included in the meta-analysis to maximize power. To this set of 36 journal articles and the unpublished PhD dissertation, data from A. R. B. Soutter's Master's degree research project were added, yielding a total of 38 sources of data.

In 30 of the 38 sources, authors had collected their own data, amounting to 34 author-collected data sets (some sources ran multiple studies). The remaining eight sources used existing data sets for a total of 9 separate existing data sets (some sources ran multiple studies with different existing data sets whereas others used the same existing data set). In sum, these sources

included data from 44,993 individuals, of which 11,813 were from the 34 author-collected data sets and 33,180 were from the 9 existing data sets. Where a study noted multiple sample sizes within a single data set (k = 7), the highest sample size was used for reporting. See Appendix A for a summary of the studies used in the meta-analysis. Most studies were conducted in Europe (32%, k = 12, N = 16,659), followed by North America (26%, k = 10, N = 4,608), Asia (24%, k = 9, N = 4,111), Australia and New Zealand (13%, k = 5, N = 15,748), and in mixed regions (8%, k = 3, N = 3,867). One source included two studies with different country samples (which is why k sums to 39 rather than the 38 sources stated above).

The articles meeting inclusion standards used a wide range of proenvironmental attitudes and behaviors. We recorded 61 measures of proenvironmental attitudes and 35 measures of proenvironmental behaviors. At times these measures were slightly different versions of the same scale, but the number of scales is indicative of the breadth of proenvironmental attitude and behavior measures studied. Measures varied in length from single-item measures ("Is climate change real?" or "Have you donated to an environmental charity?") to longer measures of broader constructs such as one's connection to nature, as measured by the Connectedness to Nature Scale (Mayer & Frantz, 2004), or scales that assess a variety of behaviors ranging, for example, from recycling to financial contributions (e.g., see Kaiser, Schultz, & Scheuthle, 2007). Measurements of behavior covered different categories as defined by Lange and Dewitte (2019), although they were predominantly self-reported. This breadth of measurement allows the results of the meta-analysis to be generalized across a variety of attitudes and behaviors rather than being restricted to specific scales (see Mõttus, 2016). Because of their diversity, this may be particularly important with regard to measuring personality traits' relationships with proenvironmental attitudes and behaviors (Lange & Dewitte, 2019). A full list of the proenvironmental attitudes and behaviors included in this meta-analysis can be found on the Open Science Framework at https://osf.io/jky45.

Publication biases

Funnel plots were used to identify publication bias by plotting effects against their standard errors to examine whether there was a trend for effect sizes as a function of standard errors (e.g., less precise studies reporting stronger associations). Egger's tests were also performed to indicate potential strengths of these publication biases. We used p-curves (i.e., the distributions of p values) to examine whether significant results indicated a true effect or could have resulted from p hacking or publication bias (Simonsohn, Nelson, & Simmons, 2014). If an effect is true these distributions tend to be skewed to the right, nonexistent effects tend to yield a flat line, and p hacking leads to a skew to the left whereby p values close to common thresholds are most common (Simonsohn, Simmons, & Nelson, 2015). The funnel plots and p-curves can be found in the Supplemental Material. To briefly summarize, p-curve analyses found that there was no indication of potential p hacking, except for the association between neuroticism and behavior.

The funnel plots supported by Egger's test showed little publication bias. Occasional evidence for biases showed a sporadic pattern, and it is therefore unlikely that there was strong overall evidence for systematic publication bias. Although there was some skew on a few graphs, only agreeableness and conscientiousness' association with behaviors and honesty-humility and openness' association with attitudes suggested some publication bias.

Main effects

A summary of the meta-analytic associations between personality domains and proenvironmental attitudes and behaviors is presented in Table 2.

Our initial analysis mapped similarly named HEXACO domains to their corresponding Big Five domains. The HEXACO honesty-humility domain was not matched with any Big Five domain but analyzed independently. This grouping ensured that the simplest model, treating trait scores exchangeably regardless of their specific model, could be examined first. However, a flag for the personality model was retained as a differentiating column in the data set, making it possible in subsequent moderation analyses to differentiate results on the basis of the personality model.

In line with our prediction, openness had the strongest association with proenvironmental attitudes, r (k = 27) = .22, p < .001. Unpredictably, however, honesty-humility had a similarly strong association, r (k = 5) = .20, p < .001. As predicted, agreeableness, r (k = 27) = .15, p < .001, and conscientiousness, r (k = 29) = .12, p < .001, had weaker associations. Neuroticism was also consistent with the prediction of a nonsignificant association with proenvironmental attitudes, r (k = 26) = .02, p = .082, although extraversion had a small but significant association, r (k = 27) = .09, p < .001.

Similar associations were found for proenvironmental behavior. We had predicted that the effect sizes would generally be smaller for behaviors than attitudes because the latter could be thought of as a more proximal variable (mediator) to the former. A visual inspection

Table 2. Summary of Main Effects

Domain and dependent variable	Fisher estimate	*SE*	I^2 (%)	Pearson correlation	*k*	Study's *N*
Agreeableness						
Attitude	0.15 [0.12, 0.18]***	0.02	94.06	.15 [.12, .18]	27 (75)	40,093 (70,920)
Behavior	0.10 [0.07, 0.14]***	0.02	75.24	.10 [.07, .14]	22 (37)	12,895 (16,143)
Conscientiousness						
Attitude	0.12 [0.10, 0.14]***	0.01	85.61	.12 [.10, .14]	29 (79)	41,669 (72,789)
Behavior	0.11 [0.07, 0.14]***	0.02	80.95	.11 [.07, .14]	25 (41)	14,646 (18,042)
Extraversion						
Attitude	0.09 [0.07, 0.11]***	0.01	86.31	.09 [.07, .11]	27 (75)	40,102 (70,947)
Behavior	0.10 [0.07, 0.14]***	0.02	72.43	.10 [.07, .14]	21 (36)	12,699 (15,947)
Honesty-humility						
Attitude	0.21 [0.14, 0.27]***	0.03	93.37	.20 [.14, .27]	5 (16)	8,335 (18,316)
Behavior	0.26 [0.15, 0.37]***	0.05	86.51	.25 [.15, .35]	5 (7)	2,336 (2,657)
Neuroticism						
Attitude	0.02 [–0.00, 0.05]	0.01	88.21	.02 [–.00, .05]	26 (73)	39,683 (70,098)
Behavior	–0.02 [–0.05, 0.01]	0.01	58.98	–.02 [–.05, .01]	22 (37)	13,161 (16,409)
Openness						
Attitude	0.22 [0.19, 0.25]***	0.01	92.15	.22 [.19, .25]	27 (74)	41,197 (71,662)
Behavior	0.21 [0.16, 0.26]***	0.03	89.18	.21 [.16, .26]	22 (37)	14,200 (17,448)

Note: Values in brackets are 95% confidence intervals. Values in parentheses are number of correlations or the *N* of all correlations.
***$p < .001$.

demonstrated that this marginally applied to three of the domains linked with attitudes (agreeableness, conscientiousness, and openness), whereas honesty-humility, $r\ (k = 5) = .25$, $p < .001$, and extraversion, $r\ (k = 21) = .10$, $p < .001$, had a somewhat stronger association with proenvironmental behavior than with attitudes, and for neuroticism the effect sizes were identical.

Moderator analysis

Because of the high heterogeneity in the main effects, indicated by high I^2 values, we conducted an exploratory analysis of the possible moderating role of the personality model used to operationalize personality (Big Five vs. HEXACO) as well as the demographic variables of age, gender, and country of origin. The analyses for age and gender were performed in a subset of data because 17 studies did not report the age of participants and 13 did not report gender distributions. There were no specific hypotheses regarding moderation. Caution must be taken when interpreting these moderations because other study characteristics may covary with the moderating variables in question. This is compounded by some moderation analyses having a small number of observations.

The first moderation analysis was conducted to address the role of the personality model, as combining similarly named constructs of the Big Five and HEXACO can be problematic (e.g., Ashton & Lee, 2007; Ashton et al., 2014; Lee et al., 2015). For moderation by personality model, the results revealed an inconsistent pattern (see Appendix B). There was no difference between the HEXACO and Big Five models for conscientiousness' association with proenvironmental attitudes, $Q_B(1) = 0.95$, $p = .330$, or behaviors, $Q_B(1) = 1.57$, $p = .210$. For agreeableness there was no difference for behaviors, $Q_B(1) = 0.43$, $p = .514$, but there was a moderating effect for attitudes, $Q_B(1) = 8.59$, $p = .003$. The HEXACO agreeableness was not significant, $r\ (k = 5) = .07$, $p = .051$, whereas the Big Five agreeableness had a significant association, $r\ (k = 22) = .17$, $p < .001$. For neuroticism, there was no difference for behaviors, $Q_B(1) = 0.37$, $p = .543$, but there was one for attitudes, $Q_B(1) = 24.22$, $p < .001$. HEXACO neuroticism (emotionality) had a significant association with attitudes, $r\ (k = 5) = .11$, $p < .001$, but the Big Five neuroticism did not, $r\ (k = 21) = -.01$, $p = .548$. No difference was found for the association of attitudes with openness, $Q_B(1) = 1.63$, $p = .202$, but the association of behaviors was moderated by personality model for openness, $Q_B(1) = 19.05$, $p < .001$. The HEXACO domain had a stronger association with behaviors for openness, $r\ (k = 5) = .39$, $p < .001$, than the Big Five, $r\ (k = 18) = .17$, $p < .001$. Last, for extraversion there was no difference for behaviors, $Q_B(1) = 2.76$, $p = .096$, but one for attitudes, $Q_B(1) = 3.99$, $p = .046$. HEXACO extraversion had a significant association with attitudes, $r\ (k = 5) = .05$, $p = .037$, as did neuroticism in the Big Five, $r\ (k = 22) = .10$, $p < .001$.

Age (see Appendix C) was a moderating factor only for the relationship between agreeableness and Behavior, $Q_B(1) = 3.94$, $p = .047$. As the mean age of the sample increased, the association between agreeableness and Behavior increased. Gender was a partial moderator of the associations of proenvironmental attitudes with agreeableness, $Q_B(1) = 6.44$, $p = .011$, and conscientiousness, $Q_B(1) = 6.07$, $p = .014$ (see Appendix D). Specifically, for agreeableness the association was smaller in the meta-analysis of samples with an above-median proportion of female participants, r ($k = 21$) = .02, $p = .721$, than in samples with a below-median proportion of female participants, r ($k = 21$) = .34, $p = .011$; the same applied to conscientiousness, r ($k = 22$) = .02, $p = .589$, and r ($k = 22$) = .23, $p < .001$, respectively. Gender also moderated the association of proenvironmental behaviors with openness, $Q_B(1) = 9.30$, $p = .002$; a higher proportion of female participants yielded a stronger association, r ($k = 16$) = .32, $p < .001$, than a lower proportion of female participants, r ($k = 16$) = .04, $p = .460$. Neither of the moderations were statistically significant after Bonferroni corrections for multiple testing except for openness and proenvironmental behavior.

The sample's country of origin was a moderator of the association of proenvironmental attitudes with agreeableness, $Q_B(4) = 24.67$, $p < .001$, conscientiousness, $Q_B(4) = 25.75$, $p < .001$, extraversion, $Q_B(4) = 35.68$, $p < .001$, honesty-humility, $Q_B(2) = 42.12$, $p < .001$, and openness, $Q_B(4) = 11.77$, $p = .002$ (see Appendix E). Specifically, samples from Asia had stronger associations with agreeableness, r ($k = 5$) = .29, $p < .001$, conscientiousness, r ($k = 5$) = .22, $p < .001$, and extraversion, r ($k = 5$) = .19, $p < .001$. For honesty-humility, Australian and New Zealand samples had a nonsignificant association, r ($k = 1$) = −.03, $p = .399$. For openness, the association was the strongest in North American samples, r ($k = 9$) = .26, $p < .001$. Country of origin was also a moderator for the association between proenvironmental behaviors and honesty-humility, $Q_B(1) = 7.36$, $p = .007$, as well as openness, $Q_B(4) = 16.26$, $p = .003$. Specifically, in North American samples, the association was weaker for honesty-humility, r ($k = 3$) = .17, $p = .001$, and Asian samples had a nonsignificant association for openness, r ($k = 4$) = .08, $p = .125$.

Prediction of proenvironmental behavior

Finally, we set out to control for overfitting of the associations in individual samples, possible systematic effects of publication biases (which tend to inflate associations), and overlaps among personality domains, as well as to ensure that the meta-analytic effects indeed have predictive value for proenvironmental attitudes and behaviors (Yarkoni & Westfall, 2017). For this, we used the Big Five's meta-analytic coefficients to predict proenvironmental attitudes and behaviors in two unpublished holdout data sets that we had previously collected and that were not included in the meta-analysis. In both data sets ($N = 499$, mean age = 40.40 years, 60.9% female; $N = 287$, mean age = 27.23 years, 72.1% female), Big Five personality domains were measured using the 120-item International Personality Item Pool scales (Johnson, 2014), whereas proenvironmental attitudes and behaviors were measured with various instruments (Table 3). In addition to scores on individual scales, combined scores for both proenvironmental attitudes and behaviors were created within each data set by standardizing scores of different scales measuring these constructs and calculating their averages. Specifically, the standardized Big Five scores in these two data sets were multiplied by corresponding domains' meta-analytic associations (for the Big Five–based instruments) with either proenvironmental attitudes or behaviors and subsequently summed, yielding predicted (from the Big Five) proenvironmental attitude and behavior scores for each individual. These predicted scores were then correlated with the measured scores of proenvironmental attitudes and behaviors. Such predictive model "training" (meta-analyses) and "validation" (correlations between predicted and observed scores) in independent participants (and even using disparate measures for the same constructs) is more common in standard machine learning, where it has been shown to mitigate potential effects of sampling biases, instrument biases, and researcher degrees of freedom. This can be thought of conceptually as a very thorough test of the degree to which personality is linked with proenvironmental attitudes and behaviors.

The Big Five-predicted proenvironmental attitude and behavior scores correlated substantially with overall proenvironmental attitudes ($r = .44$–$.45$) and behaviors ($r = .28$–$.43$). There were some differences across the particular attitude or behavior measures, but as a whole the correlations were sizable and significant for all attitude measures and for most behavior measures. A summary of the results can be found in Table 3.

Discussion

This meta-analysis examined quantitative evidence for associations of major personality domains with proenvironmental attitudes and behaviors, collating data from 44,993 participants from 38 sources representing at least 19 countries across 4 continents. Openness and honesty-humility had sizable ($r \sim .20$) associations with both proenvironmental attitudes and behaviors, whereas somewhat

Table 3. Prediction of Proenvironmental Attitudes and Behaviors

Measure	Data set 1 (N = 499)	Data set 2 (N = 287)
Proenvironmental attitude		
Revised New Ecological Paradigm (Dunlap, Van Liere, Mertig, & Jones, 2000)	.25***	.27***
Environmentalism Scale (Soutter, Bates, & Mõttus, 2019)	.45***	.48***
Connectedness to Nature Scale (Mayer & Frantz, 2004)	.47***	.37***
Combined attitude scores	.45***	.44***
Proenvironmental behavior		
Donation to environmental charity (Soutter & Boag, 2019)	.15***	.10
Future Behavior Scale	—	.38***
Proenvironmental Behavior Scale (Markle, 2013)		
Conservation	.30***	—
Citizenship	.28***	—
Food	.35***	—
Transportation	.30***	—
Environmental Behaviour (Soutter et al., 2019)		
Combined behavior scores	.43***	.28***

***$p < .001$.

weaker associations emerged for agreeableness, conscientiousness, and extraversion. Neuroticism had no significant associations with either proenvironmental attitudes or behaviors. Collectively, the Big Five domains allowed the prediction of proenvironmental attitudes and behaviors in independent samples.

Effect sizes

The significant meta-analytic effects (r) ranged between .09 and .26. Although these individual meta-analytic effect sizes might be considered small by some, they are in line with other meta-analytic associations between psychological domains and real-life outcomes. For example, the associations of the Big Five personality domains and intelligence with academic performance range up to r = .25 (Poropat, 2009), and intelligence and academic performance are clearly closely linked constructs. Furthermore, within environmental psychology, small changes in environmental attitudes or behaviors could have a substantial impact on environmental issues when aggregated across many people (Milfont & Sibley, 2012). Moreover, when it comes to democratically decided policy decisions, small influences can, at the margins, flip policy responses between starkly differing options. Finally, the combined effect sizes (r) of the Big Five domains in the prediction of proenvironmental attitudes and behaviors in independent samples were between .44 and .45 and between .28 and .43, respectively, which are strong prediction effects.

Interpretation of the associations

Openness is positively correlated with cognitive ability and being generally informed (Ackerman & Heggestad, 1997) and could therefore increase environmentalism through a greater awareness of the consequences of human's actions on the environment. Specifically, research indicates that openness is more strongly related to crystallized intelligence than to fluid intelligence (Ashton, Lee, Vernon, & Jang, 2000; Bates & Shieles, 2003). Crystallized intelligence is intelligence gained through learning and experience, such as scientific and history-related knowledge (Cattell, 1963). This strengthens the argument that higher openness is associated with environmentalism through greater environmental knowledge, but additional research should control for the effects of intelligence.

Behaving in proenvironmental ways also requires knowing and mastering new behavioral strategies, which is likely helped by cognitive abilities. People with high openness may also be more willing to accept and adopt new ideas (Hirsh, 2014) and may be more tolerant toward the out-group (Lee et al., 2015). Greater connection and care for other species, other kingdoms of life, and the wider environment of nonliving elements may be aided by this fuzzier distinction between in-groups (humans) and out-groups (other species). Last, the Aestheticism facet of openness in particular has been found to be correlated with proenvironmental attitudes and behaviors (Markowitz et al., 2012). It has

been argued that this facet is likely related to a greater aesthetic appreciation of nature, motivating a desire to preserve it (e.g., Hirsh & Dolderman, 2007).

A rationale is also available for why proenvironmental attitudes and behaviors are more likely for people with high honesty-humility. Specifically, this domain is defined by a tendency to cooperate and not to exploit others (Ashton & Lee, 2007; Lee et al., 2015). Therefore, as environmentalism suggests that it is human's exploitation of the environment that has led to the anthropogenic climate change we are currently facing (e.g., Cook et al., 2016), high honesty-humility may lead to an alignment with environmentalism. The same logic can be applied to the positive association of agreeableness with proenvironmental attitudes and behaviors. Agreeableness is associated with greater levels of empathy and compassion (Graziano & Eisenberg, 1997), which have been suggested to be one of the major predictors of proenvironmental behaviors (Schultz, 2000). Finally, as major environmental changes may take a long time to affect humans and may not directly affect the individuals who contributed to the environmental issue, taking actions that are costly to one's own convenience—as is often the case for proenvironmental actions—may require an element of empathy for future generations, other animals, or even the wider environment.

The prominent associations of honesty-humility and openness with proenvironmental attitudes and behaviors can be further explained in the wider context of personal values and worldviews. These two HEXACO domains have been found to be related to Schwartz values scores (Lee et al., 2009; Schwartz, 1992). Likewise, the Big Five's openness and agreeableness, which are most similar to the HEXACO's openness and honesty-humility (Lee et al., 2015), have been similarly related to these values (Dobewall, Aavik, Konstabel, Schwartz, & Realo, 2014; Roccas, Sagiv, Schwartz, & Knafo, 2002). Honesty-humility and openness have also been found to be the strongest correlates of sociopolitical factors such as social-conformity and social-dominance orientation (Lee, Ashton, Ogunfowora, Bourdage, & Shin, 2010). These results combined with the results of this study demonstrate that when it comes to one's personal values and worldviews, openness and honesty-humility are the key personality domains to examine.

Individuals with high conscientiousness are often characterized by goal-directed behavior, such as thinking through one's actions, delaying gratification, following norms and rules, and planning and organizing tasks (John & Srivastava, 1999). It is likely that highly conscientiousness people would be expected to carefully follow socially appropriate norms toward environmental behavior (Hirsh, 2010). However, the weaker association than openness and honesty-humility might be explained by social norms and goals being inconsistent with respect to environmental behaviors. For example, an often desirable social goal is being able to travel or own a large house. However, both of these behaviors are often not environmentally friendly. Furthermore, conscientiousness has been associated with greater wealth (e.g., Duckworth, Weir, Tsukayama, & Kwok, 2012), which in turn is linked with higher carbon emissions (e.g., Hubacek et al., 2017).

Last, those with high extraversion are often characterized as being highly social, active, and person-oriented (McCrae & Costa, 1999). This desire to engage with others could be related to proenvironmental action such as joining environmental organizations or groups or actions that increase environmental awareness (e.g., being outdoors, taking part of tours or campaigns). Furthermore, those with high extraversion may also have high self-expression and low fate control, both of which have been linked to more proenvironmental action (Inglehart & Baker, 2000; Leung & Bond, 2004).

Mediating role of attitudes between personality domains and behavior

Our prediction that personality domains would show stronger associations with proenvironmental attitudes than with proenvironmental behaviors was partly supported, at least when considering the ability of the Big Five domains to collectively predict them (see Table 3). The only exceptions to this were for honesty-humility and extraversion, possibly due to a larger number of factors connecting honesty-humility and extraversion with acting proenvironmentally. There seems to be a gap between attitudes and behaviors in the environmental context (e.g., Kollmuss & Agyeman, 2002), and these results seem to support that notion.

Moderators of the associations

We performed moderation analyses because of the high heterogeneity of the effects across individual studies to examine whether any characteristics of the study (e.g., country conducted in) could explain this variance. The proportion of female participants, age, and country of origin of samples, as well as whether the associations were based on HEXACO or the Big Five domains, moderated several associations, although no consistent patterns emerged. For example, the HEXACO construct of agreeableness had a weaker association with attitudes than the Big Five agreeableness, but there was no difference for its association with behaviors. Inversely, there was no difference between the HEXACO and Big Five on openness' association with attitudes, but the HEXACO construct of openness had a stronger association with

behaviors. Some of these differences may reflect greater similarity in the HEXACO and Big Five constructs of extraversion, conscientiousness, and openness compared with those for agreeableness and neuroticism (Lee et al., 2015). This could not explain, however, why the personality model also moderates the more similar constructs. The patterns for country, age, and proportion of female participants in the study were also not consistent. These analyses were exploratory in nature, and because of moderation creating small group sizes in some cases and because of possible covariances among the focal moderators and other study characteristics, caution must be taken when interpreting these moderation effects. Even if variations due to gender, age, country of sample, and personality model were factored into the models, the levels of heterogeneity remained high for most associations, suggesting unmeasured factors play a significant role in generating observed heterogeneity.

Limitations

Meta-analyses in general suffer from the limitations of publication bias (studies reporting only significant results being published) and selection bias, and the reliability and validity of meta-analytic estimates depend on the quality of the studies used (Rosenthal & DiMatteo, 2001). We attempted to avoid these limitations by including as comprehensive a set of findings as possible and by contacting researchers to include their unreported estimates. This was reflected in the little (and inconsistent) evidence for publication bias observed in our findings. Our study does, however, have some further potential limitations. First, we chose to examine only zero-order correlations. This is limiting because it does not take into account the reality of proenvironmental attitudes and behaviors, which are most likely influenced by several factors, for example, age, political ideology, and educational level. This idea was reflected in our high levels of heterogeneity. Personality variables also tend to overlap. We relied on zero-order correlations because studies do not consistently control for the same factors, which prevents a meta-analysis with any significant number of studies being performed. It is noteworthy, however, that the prediction models we applied in independent samples partly mitigated these issues, showing that associations between personality domains and proenvironmental attitudes and behaviors are not sample-specific and cannot be strongly inflated by the intercorrelations among personality domains. Second, we limited this meta-analysis to the broad personality domains of the HEXACO and Big Five models, restricting us from understanding which facets within these domains were driving the observed associations (Mõttus, 2016). This was done because too few individual studies had reported facet-specific associations (and the facets are inconsistent across the two personality models).

Implications

Despite these limitations, this meta-analysis provides a solid foundation for understanding the associations of major personality domains with proenvironmental attitudes and behaviors. Past research has largely ignored the role of individual differences in shaping environmentalism (Markowitz et al., 2012), whereas our meta-analysis demonstrates a sizable link between personality domains and proenvironmental attitudes and behaviors. It is therefore wise to consider the roles of personality traits when attempting to understand why people do or do not care or act in environmentally responsible ways, as well as when attempting to create effective policies and regulations to improve such behaviors and combat climate change.

Research into persuasion has long highlighted the effectiveness of tailoring messages to fit their intended audience (Cacioppo, Petty, & Sidera, 1982; Petty & Wegener, 1998). Experimental studies have also demonstrated the effectiveness of reframing messages to fit existing attitudes of the audience (e.g., Edwards, 1990; Fabrigar & Petty, 1990). Individual differences in psychological traits have featured less frequently in this field of research, but a recent example (Feinberg & Willer, 2015) reported that policies traditionally associated with a particular political orientation could gain support from those of an opposing political orientation when presented using moral values consistent with those of the opposing perspective. Furthermore, it was shown that differences in framing did not negatively affect persuasion among those who originally supported the argument. This suggests that environmental policy intervention should likely not be framed in terms that resonate with those who already support the policy; instead, framing in terms that resonate with those who least support it can be more effective. In the context of the current article, personality factors may play a significant and systematic role in such reframing.

Effective policies and strategies can be informed by the associations of openness and honesty-humility with both attitudes and behaviors. For example, because low openness is one of the barriers to proenvironmental behavior, interventions and policies may be more effective if they provide and frame the adoption of new environmentally friendly cognitive and behavioral strategies rather than framing the desired behaviors as a moral imperative. Furthermore, creating simple cognitive and behavioral strategies might further aid those with low

openness in adopting desired strategies, despite their newness, because the domain is often linked with low cognitive abilities and less knowledge, and those with low openness may be less likely to make an effort to try out something new. Furthermore, it may not be helpful to frame environmentally friendly practices as novel but rather demonstrate the extent to which they are already established; those on the lookout for novel practices are already more likely to behave proenvironmentally.

Framing interventions for proenvironmental behaviors as a moral imperative could also be ineffective because of low honesty-humility and agreeableness being among the barriers to such behaviors; the main intervention targets might simply care less about this or be less trustful of the aims of the interventions. Those more receptive to the moral aspects of proenvironmental messages are already more likely to behave in desired ways. Instead, messages could be framed in a manner that promotes or emphasizes the personal profitability of proenvironmental behaviors. For example, instead of highlighting that the use of electric vehicles is important in reducing carbon emissions that damage the environment, campaigns could highlight the financial savings of using electricity as a fuel source over petrol.

Future research on this topic should examine the effectiveness of targeting these personality domains through policies and strategies, especially through experimental designs. For example, to study effective marketing of the use of electric vehicles, one could randomly assign people into one of two groups; one group would receive marketing messages in which purchasing an electric vehicle is framed as a moral imperative (e.g., reduced carbon emissions), and the other group would receive marketing messages in which such a purchase was framed in terms of personal profit (e.g., reduced fuel cost), after which participants' honesty-humility would be measured. If participants with low honesty-humility indicate a greater willingness to purchase/use an electric vehicle in the personal-profit group than in the moral-imperative group, and those with high honesty-humility demonstrate the opposite, this would indicate the effectiveness of catering to different levels of honesty-humility in adopting environmental behaviors.

Future research should also examine factors that are potentially related to proenvironmental attitudes and behaviors. Although displaying sizable effect sizes, the broad personality domains of the HEXACO and Big Five are not the only contributors to proenvironmental attitudes and behaviors. There is research on a variety of factors that includes demographic variables such as age (e.g., Wiernik, Ones, & Dilchert, 2013), social factors such as social norms (e.g., St. John, Edwards-Jones, & Jones, 2010) and goal setting (e.g., Osbaldiston & Schott, 2012), developmental factors such as early-childhood experience with nature (e.g., Wells & Lekies, 2006), and indeed many other personality factors (e.g., time perspective: Milfont, Wilson, & Diniz, 2012; political ideology: Brick & Lewis, 2016). However, only a few studies have attempted to combine elements from separate disciplines. The use of multiple frameworks of psychology in a study, such as including all of the above factors, could provide a more holistic understanding of why people act or do not act in proenvironmental ways. This is vitally important considering the pressing risk of climate change to numerous aspects of not only humans' lives but also to the ecosystem that is Earth.

Appendix A

Table A1. Studies Included in the Meta-Analysis

Study	Country	Female participants (%)	Mean age	*N*	Measure		
					Personality	Attitude	Behavior
Abdollahi et al. (2017)	Malaysia	53	43.44	1,160	Goldberg Questionnaire (Goldberg, 1992)—translated into Malaysian (B)	Environmental concern (Hirsh, 2010)—translated into Malaysian	N/A
Boeve-de Pauw, Donche, & Van Petegem (2011)	Belgium	NR	NR	957	HiPIC (Mervielde & De Fruyt, 1999) (B)	New Environmental Paradigm for Children (Manoli, Johnson, & Dunlap, 2007)	N/A
Brick & Lewis (2016)	U.S.	53	36.70	345	HEXACO-PI-R (Lee & Ashton, 2004) (H)	Connectedness to Nature Scale (Mayer & Frantz, 2004); Revised New Environmental Paradigm (Dunlap et al., 2000)	Emissions-reducing behavior (Brick & Lewis, 2016)
Chiang, Fang, Kaplan, & Ng (2019)	Taiwan	58	NR	473	Five items based on Goldberg (1992) and Saucier (1994) (B)	—	Four items adopted from Belgrade Charter (Fielding & Head, 2012; Hungerford, 1985; United Nations Environment Programme, 1975)
Diessner, Iyer, Smith, & Haidt (2013)	Mixed	NR	NR	3,498	Big Five Inventory (John, Donahue, & Kentle, 1991) (B)	Engagement With Natural Beauty Subscale (Diessner, Solom, Frost, Parsons, & Davidson, 2008)	—
Forstmann & Sagioglou (2017)	U.S.	61	35.77	1,487	Ten-Item Personality Inventory (Gosling, Rentfrow, & Swann, 2003) (B)	Nature Relatedness (Nisbet, Zelenski, & Murphy, 2009)	Proenvironmental behavior (Whitmarsh & O'Neill, 2010)
Gordon-Wilson & Modi (2015)	U.K.	74	NR	204	Ten-Item Personality Inventory (Gosling et al., 2003) (B)	—	Ecologically Conscious Consumption Behavior—reduced to 10 items (Roberts, 1996)
Hilbig, Zettler, Moshagen, & Heydasch (2013)	Germany	65	27.30	137	HEXACO-PI-R (short version; Lee & Ashton, 2004, 2006) (H)	Kaiser, Wölfing, & Fuhrer (1999)—14 items taken	Kaiser, Schultz, & Scheuthle (2007)—18 items taken
	Germany	81	33.80	531			
Hirsh (2010)	Germany	53	14.60	2,690	Big Five Inventory (short version; Gerlitz & Schupp, 2005; John et al., 1991) (B)	Environmental concern (Hirsh, 2010)	—
Hirsh & Dolderman (2007)	Canada	70	21.00	106	Big Five Inventory (John et al., 1991) (B)	Ecological Self Scale (Dolderman, 2004); Environmental goals (Hirsh & Dolderman, 2007); Revised New Environmental Paradigm (Dunlap et al., 2000)	—

(continued)

Table A1. *(continued)*

Study	Country	Female participants (%)	Mean age	*N*	Measure		
					Personality	Attitude	Behavior
Kaynak & Ekşi (2014)	Turkey	48	NR	503	Adapted from Costa & McCrae (1992) (B)	Five items adapted from New Environment Paradigm (Roberts & Bacon, 1997)	—
A. Kim, Kim, Han, Jackson, & Ployhart (2017)	South Korea South Korea	3 20	46.68 37.59	80 325	Mini-International Personality Item Pool (Donnellan, Oswald, Baird, & Lucas, 2006) (B)	—	Voluntary work green behavior; Work group green advocacy (A. Kim et al., 2017)
J. Kim, Schmöcker, Bergstad, Fujii, & Gärling (2014)	Japan	11	20.30	640	Tsao & Chang (2010; 14 items used) (B)	Personal norm toward environmental problems (Gärling, Fujii, Gärling, & Jakobsson, 2003)—four items taken; Problem awareness of climate change (J. Kim et al., 2014)	Acceptability of environmental taxation (J. Kim et al., 2014)
Kvasova (2015)	Russia (26%); U.K. (20%); Greece (19%); Sweden (18%); Germany (17%)	53	NR	227	Mini-International Personality Item Pool (Donnellan et al., 2006) (B)	—	General Ecological Behavior (Kaiser & Wilson, 2004)—eight items (adapted to tourism context)
Lee, Ashton, Choi, & Zachariassen (2015)	Canada	63	19.70	321–324	HEXACO-PI-R (Lee & Ashton, 2004) (H)	Animal Attitudes Scale (Herzog, Betchart, & Pittman, 1991); Connectedness to Nature Scale (Mayer & Frantz, 2004); Revised New Environmental Paradigm (Dunlap et al., 2000)	Kaiser et al. (2007)—18 items taken
Liem & Martin (2015)	Australia	51	14.51	2050	International English Big-Five Mini-Markers (Thompson, 2008) (B)	Awareness of environmental issues, Concerns about environmental issues, Expectations about environmental issues, and Proenvirontmental attitudes (all from extended version of Programme for International Student Assessment 2006; OECD, 2009)	—
Luchs & Mooradian (2012)	U.S.	54	20.86	69	Ten-Item Personality Inventory (Gosling et al., 2003) (B)	Environmental responsibility (Luchs & Mooradian, 2012)	Choosing environmental shoe (Luchs & Mooradian, 2012)

(continued)

Table A1. *(continued)*

Study	Country	Female participants (%)	Mean age	*N*	Measure		
					Personality	Attitude	Behavior
Markowitz, Goldberg, Ashton, & Lee (2012)	U.S.	NR	NR	493–570	Big Five Inventory (John et al., 1991); NEO-PI-R (Costa & McCrae, 1992); HEXACO-PI-R (Lee & Ashton, 2004) (B, H)	—	Environmental Practices Scale (Markowitz et al., 2012)
	U.S.	72	19.00	115	Big Five Inventory (John et al., 1991) (B)	Connectedness to Nature Scale (Mayer & Frantz, 2004); Revised New Environmental Paradigm (Dunlap et al., 2000)	Student Environmental Behavior Scale (Markowitz et al., 2012)
Milfont & Sibley (2012)	N.Z.	59	48.00	6,507	Mini-International Personality Item Pool (Donnellan et al., 2006) (B)	Schwartz Value Survey (Schwartz, 1992)—one item	—
		36	52.68	377	Ten-Item Personality Inventory (Gosling et al., 2003) (B)	—	Electricity conservation (Milfont & Sibley, 2012)
Milfont, Milojev, Greaves, & Sibley (2015)	N.Z.	59	47.97	6,489	Mini-International Personality Item Pool 6 (Sibley et al., 2011) (H)	Climate-change reality; Climate-change anthropogenic causes (New Zealand Attitude and Values Study, 2009)—one item	—
Nisbet et al. (2009)	Canada	67	19.48	184	Big Five Inventory (John et al., 1991) (B)	Nature Relatedness (Nisbet et al., 2009); Ecology Scale–Short Form verbal commitment (Maloney, Ward, & Braucht, 1975); Ecology Scale–Short Form affect (Maloney et al., 1975); Revised New Environmental Paradigm (Dunlap et al., 2000); New Ecological Consciousness (Ellis & Thompson, 1997); Love of Animals–Modified (Ray, 1982) Self-defined environmentalist (Nisbet et al., 2009)	Ecology Scale–Short Form actual commitment (Maloney et al., 1975); Purchase of organic products (Nisbet et al., 2009); Participation in environmental organization (Nisbet et al., 2009)
	Canada	39	42.37	145		Nature Relatedness (Nisbet et al., 2009)	—
Pavalache-Ilie & Cazan (2018)	Romania	NR	NR	509	HEXACO Personality Assessment Inventory–Romanian version (Ion et al., 2017) (H)	Attitudes toward recovery and recycling (Ugulu, Sahin, & Baslar, 2013); Environmental awareness (Ugulu et al., 2013); Revised New Environmental Paradigm–Romanian version (Dunlap et al., 2000)	Proenvironmental Behavior Scale (Ugulu et al., 2013)

(continued)

Table A1. *(continued)*

Study	Country	Female participants (%)	Mean age	*N*	Measure		
					Personality	Attitude	Behavior
Pfeiler & Egloff (2018)	Germany	NR	NR	3,186–3,440	Big Five Inventory (Rammstedt & John, 2007) (B)	Appreciation of nature and concern about climate change (Gesellschaft Sozialwissenschaftlicher Infrastruktureinrichtungen, 2015); Revised New Environmental Paradigm (Dunlap et al., 2000)	Buying organic food (Pfeiler & Egloff, 2018)
Poškus & Žukauskienė (2017)	Lithuania	NR	NR	555	Big Five Inventory (John et al., 1991) (B)	Recycling attitudes; Recycling intentions; Recycling percieved behavioral control; Recycling personal norms (Poškus & Žukauskienė, 2017)	Past recycling behavior (Poškus & Žukauskienė, 2017)
Quintelier (2014)	Belgium	52	21.00	3,025	Ten-Item Personality Inventory (Gosling et al., 2003) (B)	Boycott and buycott intention (Hooghe, Havermans, Quintelier, & Dassonneville, 2011)	Boycott and buycott (Hooghe et al., 2011)
	Belgium	46	15.00	3,426	Mondak (2010) (B)	Boycott intention (Hooghe et al., 2011)	—
Soutter (2015)	Mixed	75	25.70	237	M5-50 (McCord, 2002) (B)	Biophilic Attitudes Inventory (Letourneau, 2013); Revised New Environmental Paradigm (Dunlap et al., 2000)	Donation to WWF
	Australia	77	21.58	125		Revised New Environmental Paradigm (Dunlap et al., 2000)	Donation to SaveThePlanet
Strathman, Gleicher, Boninger, & Edwards (1994)	U.S.	NR	NR	60	Goldberg Questionnaire (Goldberg, 1992) (B)	—	Proenvironmental behavior (Strathman et al., 1994)
Swami, Chamorro-Premuzic, Snelgar, & Furnham (2011)	U.K.	49	35.50	203	Ten-Item Personality Inventory (Gosling et al., 2003) (B)	—	Reduction, Reuse, and Recycling (Barr, 2007)
Tam (2013a)	China	45	20.36	320–322	Big Five Inventory (John et al., 1991) (B)	Attitudinal support for environmental causes (Milfont & Duckitt, 2010); commitment to nature (Davis, Green, & Reed, 2009); Connectedness to Nature Scale (Mayer & Frantz, 2004); Connectivity with Nature (Dutcher, Finley, Luloff, & Johnson, 2007); Emotional Affinity Toward Nature (Kals, Schumacher, & Montada, 1999); Environmental Identity Scale (Clayton 2003); Inclusion of Nature in Self (Schultz, 2001); Nature Relatedness (Nisbet et al., 2009)	Ecological behavior (Tam, 2013a)

(continued)

Table A1. *(continued)*

Study	Country	Female participants (%)	Mean age	*N*	Measure		
					Personality	Attitude	Behavior
Tam (2013b)	China	45	20.39	288	Big Five Inventory (John et al., 1991) (B)	Dispositional Empathy with Nature Scale (Tam, 2013b)	—
Tam (2015)	China	44	19.87	126	Big Five Inventory (John et al., 1991) (B)	—	Proenvironmental behavior (Tam, 2015)
Tang & Lam (2017)	China	56	24.30	406	Judge, Heller, & Mount (2002) (B)	Attitude toward green hotels; Willingness to pay for green hotels (Han et al., 2009)	—
Verma & Chandra (2018)	India	NR	NR	291	Mini-International Personality Item Pool (Donnellan et al., 2006) (B)	Attitude toward green hotels (based on Y. Kim & Han 2010; Teng, Wu, & Liu, 2013); Intention to visit green hotels (based on Chen & Tung, 2014; Han, Hsu, & Sheu, 2010)	—
Verplanken & Roy (2013)	Mixed	59	26.00	120–132	Big Five Inventory-10 (Rammstedt & John, 2007) (B)	Environmental Attitude Inventory-24 (Milfont & Duckitt, 2010); habitual ecological worrying (Verplanken & Roy, 2013)	Proenvironmental behavior (Verplanken & Roy, 2013)
White & Hyde (2012)	Australia	57	33.89	148–200	NEO-PI-R (Costa & McCrae, 1992) (B)	Recycling attitude; Recycling self-identity; Recycling Intention (White & Hyde, 2012)	Household recycling; Past household recycling (White & Hyde, 2012)
Willock et al. (1999)	U.K.	4	48.00	252	NEO-FFI (Costa & McCrae, 1992) (B)	—	EFISF2, EFOSF2, and EFAS6 (Willock et al., 1999)
Wuertz (2015)	U.S.	NR	NR	93–95	Big Five Inventory (John et al., 1991) (B)	Environmental Concern Scale (Weigal & Weigal, 1978)	General Ecological Behavior (Kaiser, 1998); Self-reported proenvironmental behavior (Schultz & Zelezny, 1998)
Zhang, Howell, & Iyer (2014)	U.S.	44	41.08	1,108	Big Five Inventory (John et al., 1991) (B)	Connectedness to Nature Scale (Mayer & Frantz, 2004)	—

Note: B = Big Five Inventory; FFI = Five-Factor Inventory; H = HEXACO; HiPIC = Hierarchical Personality Inventory for Children; NR = not reported; OECD = Organisation for Economic Co-operation; PI-R = Personality Inventory—Revised; EFISF2 = Edinburgh Farming Implementation Scale 2 - Environmental; EFOSF2 = Edinburgh Farming Objectives Scale 2 - Sustainability; EFAS6 = Edinburgh Farming Attitudes Scale 6 - Chemical Use; N.Z. = New Zealand; U.K. = United Kingdom. U.S. = United States.

Appendix B

Table B1. Summary of Personality-Model Moderation Effects

Domain, dependent variable, and model	Fisher estimate	*SE*	I^2 (%)	R^2 (%)	Pearson correlation	*k*	*N*
Agreeableness							
Attitude							
Intercept	0.18 [0.14, 0.21]***	0.02	93.00	11.84	.17 [.14, .21]	22 (59)	31,758 (52,604)
HEXACO	–0.11 [–0.19, –0.04]**	0.04			–.11 [–.18, –.04]	5 (16)	8,335 (18,316)
Behavior							
Intercept	0.10 [0.06, 0.14]***	0.02	75.43	0.00	.10 [.06, .14]	18 (30)	11,052 (13,486)
HEXACO	0.03 [–0.06, 0.11]	0.04			.03 [–.06, .11]	5 (7)	2,336 (2,657)
Conscientiousness							
Attitude							
Intercept	0.13 [0.10, 0.15]***	0.01	85.02	0.00	.13 [.10, .15]	24 (63)	33,334 (54,473)
HEXACO	–0.03 [–0.08, 0.03]	0.03			–.03 [–.08, .03]	5 (16)	8,335 (18,316)
Behavior							
Intercept	0.10 [0.06, 0.14]***	0.02	79.95	5.10	.10 [.06, .14]	21 (34)	12,803 (15,385)
HEXACO	0.06 [–0.03, 0.15]	0.05			.06 [–.03, .15]	5 (7)	2,336 (2,657)
Extraversion							
Attitude							
Intercept	0.10 [0.08, 0.13]***	0.01	85.11	4.64	.10 [.08, .13]	22 (59)	31,767 (52,631)
HEXACO	–0.05 [–0.11, –0.00]*	0.03			–.05 [–.11, –.00]	5 (16)	8,335 (18,316)
Behavior							
Intercept	0.09 [0.05, 0.13]***	0.02	69.63	11.36	.09 [.05, .13]	17 (29)	10,856 (13,290)
HEXACO	0.07 [–0.01, 0.14]	0.04			.07 [–.01, .14]	5 (7)	2,336 (2,657)
Neuroticism							
Attitude							
Intercept	–0.01 [–0.03, 0.02]	0.01	82.13	35.37	–.01 [–.03, .02]	21 (57)	31,348 (51,812)
HEXACO	0.12 [0.07, 0.17]***	0.02			.12 [.07, .17]	5 (16)	8,335 (18,316)
Behavior							
Intercept	–0.02 [–0.06, 0.01]	0.02	59.77	0.00	–.02 [–.06, .01]	18 (30)	11,318 (13,752)
HEXACO	0.02 [–0.05, 0.09]	0.03			.02 [–.05, .09]	5 (7)	2,336 (2,657)
Openness							
Attitude							
Intercept	0.21 [0.18, 0.24]***	0.02	92.69	1.13	.21 [.18, .24]	22 (58)	32,862 (53,346)
HEXACO	0.04 [–0.02, 0.11]	0.03			.04 [–.02, .11]	5 (16)	8,335 (18,316)
Behavior							
Intercept	0.17 [0.12, 0.21]***	0.02	82.63	41.66	.17 [.12, .21]	18 (30)	12,357 (14,791)
HEXACO	0.22 [0.12, 0.32]***	0.05			.22 [.12, .31]	5 (7)	2,336 (2,657)

Note: Values in brackets are 95% confidence intervals. Values in parentheses indicate number of correlations or the *N* of all correlations.
*$p < .05$. **$p < .01$.***$p < .001$.

Appendix C

Table C1. Summary of Age-Moderation Effects

Domain, dependent variable, and model	Fisher estimate	*SE*	I^2 (%)	R^2 (%)	Pearson correlation	*k*	*N*
Agreeableness							
Attitude							
Intercept	0.18 [0.08, 0.29]**	0.05	93.65	0.00	.18 [.08, .28]	20 (58)	30,561 (51,233)
Age	–0.00 [–0.00, 0.00]	0.00			–.00 [–.00, .00]		
Behavior							
Intercept	0.02 [–0.06, 0.10]	0.04	17.83	56.36	.02 [–.06, .10]	14 (23)	6,903 (8,180)
Age	0.00 [0.00, 0.00]	0.00			.00 [.00, .00]		
Conscientiousness							
Attitude							
Intercept	0.10 [0.04, 0.17]**	0.03	81.20	0.00	.10 [.04, .16]	21 (60)	31,842 (52,508)
Age	0.00 [–0.00, 0.00]	0.00			.00 [–.00, .00]		
Behavior							
Intercept	0.03 [–0.11, 0.18]	0.07	74.44	4.05	.03 [–.11, .17]	16 (25)	8,590 (9,867)
Age	0.00 [–0.00, 0.01]	0.00			.00 [–.00, .01]		
Extraversion							
Attitude							
Intercept	0.10 [0.03, 0.17]**	0.04	86.13	0.00	.10 [.03, .17]	20 (58)	30,561 (51,233)
Age	–0.00 [–0.00, 0.00]	0.00			–.00 [–.00, .00]		
Behavior							
Intercept	0.06 [–0.07, 0.19]	0.07	65.47	0.00	.06 [–.07, .19]	13 (22)	6,700 (7,977)
Age	0.00 [–0.00, 0.00]	0.00			.00 [–.00, .01]		
Honesty-humility							
Attitude							
Intercept	0.36 [0.13, 0.58]**	0.11	93.97	16.31	.34 [.13, .52]	4 (12)	7,826 (16,280)
Age	–0.01 [–0.01, 0.00]	0.00			–.01 [–.01, .00]		
Behavior							
Intercept	1.06 [–0.15, 2.28]	0.62	80.38	19.29	.79 [–.15, .98]	2 (3)	1,013 (1,013)
Age	–0.02 [–0.06, 0.02]	0.02			–.02 [–.06, .02]		
Neuroticism							
Attitude							
Intercept	0.02 [–0.07, 0.10]	0.04	89.80	0.00	.02 [–.07, .10]	19 (61)	30,155 (50,421)
Age	0.00 [–0.00, 0.00]	0.00			.00 [–.00, .00]		
Behavior							
Intercept	0.01 [–0.09, 0.11]	0.05	43.51	0.00	.01 [–.09, .11]	13 (22)	6,700 (7,977)
Age	–0.00 [–0.00, 0.00]	0.00			–.00 [–.00, .00]		
Openness							
Attitude							
Intercept	0.27 [0.18, 0.36]***	0.05	91.51	0.00	.26 [.18, .35]	20 (57)	31,642 (51,908)
Age	–0.00 [–0.00, 0.00]	0.00			–.00 [–.00, .00]		
Behavior							
Intercept	0.27 [0.10, 0.45]**	0.09	84.35	0.00	.27 [.10, .42]	14 (23)	8,187 (9,464)
Age	–0.00 [–0.01, 0.00]	0.00			–.00 [–.01, .00]		

Note: Values in brackets are 95% confidence intervals. Values in parentheses indicate number of correlations or the *N* of all correlations.
**$p < .01$. ***$p < .001$.

Appendix D

Table D1. Summary of Moderation Effects in Female Participants

Domain, dependent variable, and model	Fisher estimate	*SE*	I^2 (%)	R^2 (%)	Pearson correlation	*k*	*N*
Agreeableness							
Attitude							
Intercept	0.35 [0.20, 0.51]***	0.08	93.32	9.56	.34 [.20, .47]	21 (59)	31,064 (51,736)
Female	–0.33 [–0.59, –0.08]*	0.13			–.32 [–.53, –.08]		
Behavior							
Intercept	0.14 [0.05, 0.23]**	0.05	75.82	0.00	.14 [.05, .23]	16 (25)	7,334 (8,611)
Female	–0.05 [–0.23, 0.13]	0.09			–.05 [–.23, .13]		
Conscientiousness							
Attitude							
Intercept	0.23 [0.13, 0.33]***	0.05	81.91	7.78	.23 [.13, .32]	22 (61)	32,345 (53,011)
Female	–0.21 [–0.37, –0.04]*	0.08			–.21 [–.36, –.04]		
Behavior							
Intercept	0.10 [0.01, 0.20]*	0.05	77.95	0.00	.10 [.01, .20]	18 (27)	9,021 (10,298)
Female	0.05 [–0.13, 0.23]	0.09			.05 [–.13, .23]		
Extraversion							
Attitude							
Intercept	0.14 [0.03, 0.25]*	0.06	86.66	0.00	.14 [.03, .24]	21 (59)	31,064 (51,736)
Female	–0.08 [–0.27, 0.11]	0.10			–.08 [–.26, .11]		
Behavior							
Intercept	0.10 [0.01, 0.19]	0.05	72.91	0.00	.10 [.01, .19]	15 (24)	7,131 (8,408)
Female	0.03 [–0.14, 0.20]	0.09			.03 [–.14, .20]		
Honesty-humility							
Attitude							
Intercept	–0.08 [–0.87, 0.71]	0.40	95.46	0.00	–.08 [–.70, .61]	4 (12)	7,826 (16,280)
Female	0.43 [–0.83, 1.68]	0.64			.40 [–.68, .93]		
Behavior							
Intercept	–0.11 [–0.74, 0.52]	0.32	52.46	50.42	–.11 [–.63, .48]	2 (3)	1,013 (1,013)
Female	0.70 [–0.22, 1.62]	0.47			.61 [–.22, .93]		
Attitude							
Intercept	–0.05 [–0.17, 0.08]	0.06	89.88	0.87	–.04 [–.17, .08]	20 (57)	30,658 (50,924)
Female	0.12 [–0.09, 0.33]	0.11			.12 [–.09, .32]		
Behavior							
Intercept	–0.02 [–0.09, 0.06]	0.04	61.87	0.00	–.02 [–.09, .06]	16 (25)	7,604 (8,881)
Female	–0.00 [–0.15, 0.14]	0.07			–.00 [–.15, .14]		
Openness							
Attitude							
Intercept	0.14 [0.01, 0.27]*	0.07	91.47	2.97	.14 [.01, .27]	21 (58)	32,145 (52,411)
Female	0.16 [–0.06, 0.39]	0.12			.16 [–.06, .37]		
Behavior							
Intercept	0.04 [–0.06, 0.14]	0.05	81.40	32.71	.04 [–.06, .14]	16 (25)	8,618 (9,895)
Female	0.30 [0.11, 0.49]**	0.10			.29 [.11, .45]		

Note: Values in brackets are 95% confidence intervals. Values in parentheses indicate number of correlations or the *N* of all correlations.
*$p < .05$. **$p < .01$. ***$p < .001$.

Appendix E

Table E1. Summary of Country-Moderation Effects

Domain, dependent variable, and model	Fisher estimate	*SE*	I^2 (%)	R^2 (%)	Pearson correlation	*k*	*N*
Agreeableness							
Attitude (Europe intercept)							
Intercept	0.10 [0.05, 0.16]**	0.03	91.73	25.21	.10 [.05, .16]	8 (18)	15,241 (25,465)
Asia	0.20 [0.11, 0.28]***	0.04			.19 [.11, .27]	5 (14)	2,816 (6,114)
Mixed	0.00 [–0.10, 0.10]	0.05			.00 [–.09, .10]	3 (11)	3,867 (5,646)
North America	0.02 [–0.06, 0.10]	0.04			.02 [–.06, .10]	8 (24)	2,489 (5,885)
Aus/N.Z.	0.03 [–0.07, 0.13]	0.05			.03 [–.07, .13]	4 (8)	15,171 (27, 810)
Behavior (Europe intercept)							
Intercept	0.13 [0.07, 0.18]***	0.03	75.01	0.00	.13 [.07, .18]	10 (12)	8,833 (9,337)
Asia	–0.00 [–0.10, 0.10]	0.05			–.00 [–.10, .10]	5 (7)	1,492 (1,897)
Mixed	0.01 [–0.16, 0.18]	0.09			.01 [–.16, .18]	2 (2)	369 (369)
North America	–0.06 [–0.14, 0.02]	0.04			–.06 [–.14, .02]	6 (14)	1,699 (4,038)
Aus/N.Z.	0.01 [–0.15, 0.18]	0.08			.01 [–.15, .18]	2 (2)	502 (502)
Conscientiousness							
Attitude (Europe intercept)							
Intercept	0.11 [0.08, 0.15]***	0.02	80.27	26.81	.11 [.08, .15]	9 (18)	15,251 (25,477)
Asia	0.11 [0.05, 0.17]**	0.03			.11 [.05, .17]	5 (14)	2,701 (5,884)
Mixed	0.01 [–0.06, 0.08]	0.03			.01 [–.06, .08]	3 (11)	3,867 (5,646)
North America	–0.03 [–0.09, 0.02]	0.03			–.03 [–.09, .02]	9 (25)	3,976 (7,372)
Aus/N.Z.	–0.03 [–0.09, 0.03]	0.03			–.03 [–.09, .03]	5 (11)	15,371 (28,410)
Behavior (Europe intercept)							
Intercept	0.09 [0.02, 0.15]**	0.03	79.68	3.36	.09 [.02, .15]	9 (12)	8,837 (9,341)
Asia	0.06 [–0.05, 0.17]	0.06			.06 [–.05, .17]	4 (7)	1,492 (1,897)
Mixed	0.10 [–0.08, 0.29]	0.09			.10 [–.08, .28]	2 (2)	369 (369)
North America	–0.01 [–0.10, 0.08]	0.04			–.01 [–.10, .08]	8 (16)	3,246 (5,585)
Aus/N.Z.	0.11 [–0.03, 0.24]	0.07			.11 [–.03, .24]	3 (4)	702 (850)
Extraversion							
Attitude (Europe intercept)							
Intercept	0.07 [0.04, 0.10]***	0.02	77.80	40.65	.07 [.04, .10]	9 (18)	15,759 (25,492)
Asia	0.12 [0.07, 0.18]***	0.03			.12 [.07, .17]	5 (14)	2,816 (6,114)
Mixed	0.06 [–0.00, 0.13]	0.03			.06 [–.00, .13]	3 (11)	3,867 (5,646)
North America	–0.02 [–0.08, 0.03]	0.03			–.02 [–.08, .03]	8 (24)	2,489 (5,885)
Aus/N.Z.	–0.04 [–0.10, 0.02]	0.03			–.04 [–.10, .02]	4 (8)	15,171 (27,810)
Behavior (Europe intercept)							
Intercept	0.13 [0.07, 0.19]***	0.03	84.15	0.00	.13 [.07, .19]	8 (11)	8,637 (9,141)
Asia	–0.03 [–0.13, 0.07]	0.05			–.03 [–.13, .07]	4 (7)	1,492 (1,897)
Mixed	–0.07 [–0.24, 0.10]	0.09			–.07 [–.23, .10]	2 (2)	369 (369)
North America	0.03 [–0.11, 0.05]	0.04			–.03 [–.11, .05]	6 (14)	1,699 (4,038)
Aus/N.Z.	–0.08 [–0.25, 0.08]	0.08			–.08 [–.24, .08]	2 (2)	502 (502)
Honesty-humility							
Attitude (Europe intercept)							
Intercept	0.28 [0.22, 0.34]***	0.03	71.07	81.32	.27 [.22, .32]	2 (6)	1,177 (2,704)
North America	–0.06 [–0.14, 0.02]	0.04			–.06 [–.14, .02]	2 (8)	669 (2,634)
Aus/N.Z.	–0.31 [–0.41, –0.22]***	0.05			–.30 [–.39, –.21]	1 (2)	6,489 (12,978)
Behavior (Europe intercept)							
Intercept	0.38 [0.26, 0.49]***	0.06	71.87	58.73	.36 [.26, .46]	2 (3)	1,177 (1,177)
North America	–0.21 [–0.36, –0.06]**	0.08			–.21 [–.35, –.06]	3 (4)	1,159 (1,480)
Aus/N.Z.							
Agreeableness							
Attitude (Europe intercept)							
Intercept	0.02 [–0.02, 0.06]	0.02	85.55	15.51	.02 [–.02, .06]	8 (18)	15,746 (25,455)

(continued)

Table E1. *(continued)*

Domain, dependent variable, and model	Fisher estimate	*SE*	I^2 (%)	R^2 (%)	Pearson correlation	*k*	*N*
Asia	–0.06 [–0.13, 0.01]	0.04			–.06 [–.13, .01]	4 (12)	2,410 (5,302)
Mixed	–0.04 [–0.12, 0.03]	0.04			–.04 [–.12, .03]	3 (11)	3,867 (5,646)
North America	0.05 [–0.01, 0.11]	0.03			.05 [–.01, .11]	8 (24)	2,489 (5,885)
Aus/N.Z.	0.01 [–0.07, 0.08]	0.04			.01 [–.07, .08]	4 (8)	15,171 (27,810)
Behavior (Europe intercept)							
Intercept	–0.01 [–0.06, 0.03]	0.02	54.42	13.85	–.01 [–.06, .03]	8 (11)	8,626 (9,130)
Asia	–0.06 [–0.14, 0.01]	0.04			–.06 [–.14, .01]	5 (8)	1,965 (2,370)
Mixed	0.09 [–0.05, 0.22]	0.07			.09 [–.05, .22]	2 (2)	369 (369)
North America	0.01 [–0.05, 0.07]	0.03			.01 [–.05, .07]	6 (14)	1,699 (4,038)
Aus/N.Z.	–0.08 [–0.21, 0.05]	0.07			–.08 [–.21, .05]	2 (2)	502 (502)
Openness							
Attitude (Europe intercept)							
Intercept	0.18 [0.12, 0.23]***	0.03	90.47	13.42	.17 [.12, .22]	8 (18)	15,773 (25,532)
Asia	0.07 [–0.02, 0.15]	0.04			.07 [–.02, .15]	4 (12)	2,410 (5,302)
Mixed	0.08 [–0.01, 0.17]	0.05			.08 [–.01, .17]	3 (11)	3,867 (5,646)
North America	0.10 [0.02, 0.17]**	0.04			.10 [.02, .17]	9 (25)	3,976 (7,372)
Aus/N.Z.	–0.03 [–0.12, 0.06]	0.05			–.03 [–.12, .06]	4 (8)	15,171 (27,810)
Behavior (Europe intercept)							
Intercept	0.22 [0.14, 0.29]***	0.04	84.35	31.61	.21 [.14, .28]	8 (11)	8,651 (9,155)
Asia	–0.14 [–0.26, –0.01]*	0.06			–.14 [–.26, –.01]	4 (7)	1,492 (1,897)
Mixed	–0.10 [–0.31, 0.10]	0.10			–.10 [–.30, .10]	2 (2)	369 (369)
North America	0.09 [–0.01, 0.19]	0.05			.09 [–.01, .18]	7 (15)	3,186 (5,525)
Aus/N.Z.	–0.14 [–0.34, 0.06]	0.10			–.14 [–.33, .06]	2 (2)	502 (502)

Note: Values in brackets are 95% confidence intervals. Values in parentheses indicate number of correlations or the *N* of all correlations. Aus/N.Z. = Australia and New Zealand.
*$p < .05$. **$p < .01$. ***$p < .001$.

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4.2 Chapter Conclusion

In this chapter we performed a meta-analysis which examined the associations between the personality domains of the Big Five and HEXACO, and pro-environmental attitudes and behaviours. Openness and Honesty-Humility were found to be strongly and positively associated with pro-environmental attitudes and behaviours. Agreeableness, Conscientiousness, and Extraversion were also positively associated with pro-environmental attitudes and behaviours, but to a lesser extent. Lastly, Neuroticism was not associated with pro-environmental attitudes and behaviours. The heterogeneity among effect sizes was partly explained by characteristics of the samples' gender ratio, age, and country of origin, as well as the personality model used within a study. In addition to this meta-analysis, we examined the ability of these personality traits, collectively, to predict pro-environmental attitudes and behaviours in holdout datasets. Using methods from machine learning (Yarkoni & Westfall, 2017) it was found that collectively these personality traits predicted pro-environmental attitudes and behaviours.

As climate change becomes a more pressing issue, policymakers are increasingly looking towards the social sciences for effective ways to deal with climate change and other environmental issues (Maki, Cohen, & Vandenbergh, 2018). Meta-analyses, such as the one presented in this chapter, are effective tools for scientists to communicate and summarise the state of the research on a topic to policymakers (Maki et al., 2018). This meta-analysis demonstrated the importance of personality, an aspect of individual differences, in understanding pro-environmental attitudes and behaviours. Modifying interventions to account for individual differences had been found to be an effective way to raise support for polices that would be traditionally opposed by certain individuals (Feinberg & Willer, 2015). Thus, the results of Chapter 4 could be used to assist policymakers, and others, in the development of effective interventions to promote pro-environmental behaviours. For

example, the results of this chapter found that those low in Openness and Honesty-Humility were the least likely to engage in pro-environmental behaviours. Thus, effective interventions that aim to promote pro-environmental behaviours should not focus on the moral imperativeness or novelty of such actions. Instead effective interventions should focus on simple cognitive and behavioural strategies that emphasise the personal benefits of enacting these strategies. This is because individuals low in Openness and Honesty-Humility might simply care less about moral and novel framings or be less trustful of the aims of the interventions.

Although this meta-analysis provided meaningful insight into how personality was associated with pro-environmental attitudes and behaviours, it had several limitations. One limitation was that we focused exclusively on the domains of the Big Five and HEXACO models of personality. These domains can be broken down into narrower constructs called facets. Facets could be potentially useful, because they contain a substantial amount of unique information about how people differ in personality above and beyond the domains under which they are subsumed (e.g. Elleman, Condon et al., 2020; Elleman, McDouglad et al., 2020; Mõttus, 2016; Mõttus & Rozgonjuk, 2019; Paunonen & Ashton, 2001; Vainik et al., 2019). Thus, as we only examined personality on a domain-level, some useful information might be missed. It was this limitation that we addressed in Chapter 5.

In Chapter 5 we examined the personality associations identified in this chapter at a facet-level. We examined whether facet-level information provided a greater understanding of personality's associations with pro-environmental attitudes and behaviours. Furthermore, we examined if this greater understanding translated into a better ability to predict pro-environmental attitudes and behaviours from personality traits.

Chapter 5: Big Five Facet's Associations with Pro-Environmental Attitudes and Behaviours

5.1 Chapter Introduction

In Chapter 4 we assessed how the domains of the Big Five were associated with pro-environmental attitudes and behaviours. It was found that Big Five Openness was the most strongly associated domain with pro-environmental attitudes and behaviours (r = .21 and .17 respectively). Big Five Agreeableness, Conscientiousness, and Extraversion were also associated with pro-environmental attitudes (r = .10 to .18) and behaviours (r = .09 to .10), but to a lesser extent. Lastly, Big Five Neuroticism was not associated with pro-environmental attitudes and behaviours (r = -.01 and -.02 respectively). Collectively these domains provided substantial predictive value for pro-environmental attitudes (r = .44 to .45) and behaviours (r = .28 to .43) in independent holdout datasets. This demonstrated the importance of examining personality's associations with pro-environmental attitudes and behaviours. However, these associations were only examined at a domain-level.

The Big Five is a hierarchical model which consists of five broad domains: Neuroticism, Extraversion, Openness, Agreeableness, and Conscientiousness (Goldberg, 1990; McCrae & John, 1992). As discussed in Chapter 1 this level of the Big Five (i.e. domains) can be broken down into narrower levels (i.e. facets; Costa & McCrae, 1992; John & Srivastava, 1999; Markowitz et al., 2012). Examining facets could be potentially useful, as facets contain a substantial amount of unique information about how people differ in personality above and beyond the domains under which they are subsumed (e.g. Elleman, Condon et al., 2020; Elleman, McDouglad et al., 2020; Mõttus, 2016; Mõttus & Rozgonjuk, 2019; Paunonen & Ashton, 2001; Vainik et al., 2019). In other areas of psychology, it had been found that understanding personality at narrower levels (i.e. facets) provided not only a greater understanding of how personality was associated with outcomes, but also increased the ability to predict these outcomes from personality traits (e.g. Mõttus & Rozgonjuk, 2019; Vainik et al., 2019).

Examining these facet-level associations could provide theoretical and practical benefits. For example, it is possible that some facets within a domain, say Neuroticism, are positively, and others negatively, associated with pro-environmental attitudes and behaviours. Thus, in the extreme, when these facets are aggregated at the domain-level, might result in Neuroticism having no overall association with pro-environmental attitudes and behaviours. Another benefit of examining these facet-level associations could be their practical application in designing interventions to promote pro-environmental attitudes and behaviours. Understanding which facets potentially drive domain-level associations, might allow further refinement of interventions that use personality traits to promote pro-environmental attitudes and behaviours. For example, if facets that were associated with empathy and compassion were revealed to be the main drivers of Agreeableness' associations with pro-environmental attitudes and behaviours, then policymakers could focus on these facets, instead of all of them, when designing interventions to promote pro-environmental attitudes and behaviours.

Although there were benefits, both theoretically and practically, to examining facet-level associations, there had been little research into how facets were associated with pro-environmental attitudes and behaviours. A literature search combined with the papers found in Chapter 4 found only six papers that explicitly examined facet-level associations. The studies that were conducted found that certain facets do indeed drive domain-level associations. Some studies found that facets within a domain had consistent associations with pro-environmental attitudes and behaviors (Brick & Lewis, 2016), while others found the opposite (i.e. contradictory facet associations within a domain; Markowitz et al., 2012).

It was for these reasons, as well as the limitation mentioned in Chapter 4 that our meta-analysis only focused on domain-level associations, that we examined how facets were associated with pro-environmental attitudes and behaviours in Chapter 5. These facet-level associations were then compared to domain-level associations. Furthermore, this chapter

examined whether facets, compared to domains, provided a greater ability to predict pro-environmental attitudes and behaviours from personality traits.

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Big Five facets' associations with pro-environmental attitudes and behaviors

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Abstract

Climate change mandates us to understand why individuals do (not) behave pro-environmentally and personality traits are well suited for this purpose. Past research has mostly focused on how broad domain-level personality traits were associated with pro-environmental attitudes and behaviors. In two datasets ($N = 501$ and 287), we examined whether personality facets provided a more detailed picture of how personality traits were associated with pro-environmental attitudes and behaviors. It was found that some facets were the main drivers of domain-level associations. Furthermore, it was found that facets, collectively, predicted pro-environmental attitudes ($r = .50$ to $.52$) and behaviors ($r = .29$ to $.42$) in holdout datasets. This predictive ability was on par with the predictive ability of domains. Therefore, facets provided a greater understanding of how personality traits were associated with pro-environmental attitudes and behaviors. Furthermore, facets provided a similar predictive ability of pro-environmental attitudes and behaviors to that of domains.

KEYWORDS

Big Five, environmentalism, facets, personality, prediction

1 | INTRODUCTION

Conservation psychology aims to (a) understand why people do (not) behave in a pro-environmental manner and (b) identify ways to promote pro-environmental behaviors (Clayton & Brook, 2005). Within conservation psychology, there are two main variables of interest: pro-environmental attitudes and behaviors. Pro-environmental attitudes can broadly be defined as one's tendency to exhibit favor toward the natural environment (Hawcroft & Milfont, 2010; Milfont, 2007). Pro-environmental behaviors are concrete actions (including not taking an action), whether deliberate or not, that positively impacts the natural environment (Soutter, Bates, & Mõttus, 2020).

Previous research had identified several variables that were associated with pro-environmental attitudes and behaviors. For example, an early meta-analysis identified cognitive variables, such as knowledge of the environment or environmental issues, as being meta-analytically associated with pro-environmental behaviors ($r = .30$; Hines, Hungerford, & Tomera, 1987). In this meta-analysis several psycho-social variables were also found to be moderately to strongly associated with pro-environmental behaviors: pro-environmental attitudes ($r = .35$), locus of control ($r = .37$), economic orientation ($r = .16$), personal responsibility ($r = .33$), and verbal commitment ($r = .49$). Lastly, it was found that demographic variables were weakly to moderately associated with pro-environmental behaviors: gender ($r = .08$), age ($r = -.15$), income ($r = .16$), and education ($r = .19$).

A later meta-analysis (Bamberg & Möser, 2007) examined similar variables in association with pro-environmental

behaviors. The cognitive variable of knowledge was re-defined as problem awareness and had a weaker association with pro-environmental behaviors than had been found earlier ($r = .19$). However, other variables such as pro-environmental attitudes ($r = .42$), perceived behavioral control ($r = .30$; re-named locus of control), moral norm ($r = .39$; re-named personal responsibility), and intention ($r = .52$; re-named verbal commitment) were associated with pro-environmental behaviors similarly to the previous meta-analysis. This meta-analysis did not address the demographic variables of gender, age, income, and education but found that social norms ($r = .31$), feelings of guilt ($r = .30$), and internal attribution ($r = .24$) were associated with pro-environmental behaviors.

These meta-analyses identified personality traits as being associated with pro-environmental behaviors, but focused on a few specific personality traits (e.g., locus of control, economic orientation, and personal responsibility). Subsequent research has also considered broader domains of personality.

1.1 | Personality and conservation psychology

Personality research has become increasingly involved in conservation psychology (e.g., Hirsh, 2010, 2014; Klein, Heck, Reese, & Hilbig, 2019; Markowitz, Goldberg, Ashton, & Lee, 2012; Milfont & Sibley, 2012; Soutter et al., 2020). Within this growing body of research, an increasing number of studies have used the broad personality domains of the Big Five/Five-Factor Model (referred to throughout as Big Five; Goldberg, 1990; McCrae & John, 1992) and the HEXACO (Ashton & Lee, 2007). It was demonstrated that pro-environmental attitudes and behaviors were robustly associated with the domains of Honesty-Humility, and Openness, and to a smaller extent Agreeableness, Conscientiousness, and Extraversion (Soutter et al., 2020). Collectively, the Big Five domains predicted pro-environmental attitudes and behaviors in independent samples with an accuracy around $r = .28$ to .45 (Soutter et al., 2020).

However, the Big Five and HEXACO domains constitute only one level of the personality trait hierarchy. Each of these domains can be split into facets. Although the exact structure of facets is still debated and authors have proposed different solutions (e.g., Ashton & Lee, 2007; Condon, 2018; Soto & John, 2017), the 30-facet solution implemented in the Revised NEO Personality Inventory (six for each Big Five domain; NEO-PI-R; Costa & McCrae, 1992) has been widely used. Facets contain a substantial amount of unique information about how people differ in personality, above and beyond the domains under which they are subsumed (e.g., Elleman, Condon, Holtzman, Allen, & Revelle, 2020; Elleman, McDouglad, Condon, & Revelle, 2020; Mõttus, 2016; Mõttus & Rozgonjuk, 2019; Paunonen & Ashton, 2001; Vainik et al., 2019).

1.2 | Benefits of facet-level associations

There are two primary benefits to examining facet-level associations, as opposed to domain-level associations, when examining how personality traits are associated with other variables. First, by examining facet-level associations, researchers can understand more specifically which facets within a domain are driving its associations. For example, Openness has been found to be positively associated with pro-environmental attitudes and behaviors (Soutter et al., 2020), but it is yet unclear if this generalizes to all of Openness' facets (Puech, Dougal, Deery, Waddell, & Mõttus, 2019). If the association only pertains to a selection of facets, it is inappropriate to interpret associations at the domain-level (Mõttus, 2016). It is even possible that some facets of, say, Neuroticism are positively associated, and others negatively associated with pro-environmental attitudes and behaviors; they would cancel out at a domain-level, resulting in no overall association between Neuroticism and pro-environmental attitudes and behaviors (Soutter et al., 2020). Practically speaking, having a more detailed knowledge of what exactly it is within any given personality domain that drives its association with pro-environmental attitudes and behaviors, could potentially be translated into more efficiently targeted interventions. For example, by focusing specifically on facets that are associated with pro-environmental attitudes and behaviors as opposed to those that are not.

Another possible benefit of examining how personality is associated with pro-environmental attitudes and behaviors at a facet-level may be increased out-sample predictive power (i.e., prediction of the outcome in people not used in mapping out the associations in the first place; Yarkoni & Westfall, 2017). Soutter and colleagues (2020) demonstrated that pro-environmental attitudes and behaviors could be out-sample predicted from the Big Five domain scores. Research in other areas, such as age and obesity, have shown that facets provided even greater predictive ability (Mõttus & Rozgonjuk, 2019; Vainik et al., 2019). This has not yet been tested for pro-environmental attitudes or behaviors.

1.3 | Existent facet-level findings

Compared to research on domains, there have been fewer studies on facet-level associations, but the studies that have been conducted found that certain facets, indeed, drive the domain-level associations. Some studies have found that facets of the same domains were consistently associated with pro-environmental behaviors (Brick & Lewis, 2016), while others had found the opposite, which might explain a lack of an association at the domain level (Markowitz et al., 2012).

Specifically, the facets of Openness generally tend to have the strongest associations with pro-environmental attitudes and behaviors (Markowitz et al., 2012). Among these facets, those that describe aesthetic appreciation tend to have the most consistent and strongest associations (Brick & Lewis, 2016; Diessner, Davis, & Toney, 2009; Klein, 2015; Markowitz et al., 2012; Puech et al., 2019). It is thus possible that greater aesthetic appreciation of nature motivates a desire to preserve the environment (e.g., Hirsh & Dolderman, 2007). Another aspect of Openness that has appeared to be consistently associated with pro-environmental attitudes and behaviors is intellectual curiosity (Boeve-de Pauw, Donche, & Van Petegem, 2011; Brick & Lewis, 2016; Markowitz et al., 2012). It is perhaps a drive for knowledge as well as a greater understanding of humanity's impact on nature that pushes people to be pro-environmental. However, research suggested that the unconventionality aspect of Openness was only associated with pro-environmental attitudes and not pro-environmental behaviors (Brick & Lewis, 2016).

Among the facets of Agreeableness, those associated with empathy and altruism, have been suggested to be the most important facets in driving Agreeableness' associations with pro-environmental attitudes and behaviors (Markowitz et al., 2012). Indeed, environmental change may take a long time or even never impact those who contributed to the environmental issue. Thus, taking actions that might be costly to one's self may require an element of empathy for future generations, other animals, or even the wider environment (Soutter et al., 2020). However, past research on these facets had been inconsistent. For example, Markowitz and colleagues (2012) found no consistent associations with the facets of Agreeableness and pro-environmental attitudes, as measured by the New Ecological Paradigm. In contrast, Klein (2015) found that altruism and tendermindedness were consistently associated with pro-environmental workplace motivations. Irritability, dominance, and egocentrism facets had been shown to be negatively associated with pro-environmental attitudes (Boeve-de Pauw et al., 2011).

The facets of Conscientiousness also vary in their associations with pro-environmental attitudes and behaviors (Klein, 2015; Markowitz et al., 2012). For example, facets to do with perseverance and self-discipline might be positively associated with pro-environmental attitudes and behaviors, as enacting environmental behaviors requires a persistent repetition of environmental behaviors across time and situations (Boeve-de Pauw et al., 2011; Brick & Lewis, 2016; Markowitz et al., 2012; Pettus & Giles, 1987). In contrast, facets to do with the order have been found to be less consistently associated with pro-environmental attitudes and behaviors (Markowitz et al., 2012; White & Hyde, 2012).

The HEXACO model also includes the domain of Honesty-Humility, which is associated with the domains of Agreeableness and Conscientiousness in the Big Five (Ashton & Lee, 2020; Lee, Ashton, Choi, & Zachariassen, 2015). Facets that tap greed avoidance had been shown to be positively associated with pro-environmental attitudes and behaviors (Brick & Lewis, 2016; Markowitz et al., 2012). This makes sense as the current ecological crisis can be accounted for by the exploitation of natural resources by humanity. Furthermore, caring for others and indeed the wider environment is unlikely to fit with a self-focused personality.

Last, the facets of Neuroticism and Extraversion had been inconsistently associated with pro-environmental attitudes and behaviors (e.g., Boeve-de Pauw et al., 2011; Brick & Lewis, 2016; Markowitz et al., 2012). For example, the socially orientated facets of Extraversion were associated with pro-environmental behaviors but were not consistently associated with pro-environmental attitudes (Brick & Lewis, 2016). Facets assessing warmth and positive emotions were also associated with pro-environmental motivations (Klein, 2015). It might be that Extraversion is associated with pro-environmental attitudes and behaviors when these attitudes and behaviors have a more socially rewarding aspect to them or involve socially acting within the environment (e.g., nature walks and outdoor sports).

1.4 | Present study

This study aimed to explore whether facets provided a more detailed picture of how pro-environmental attitudes and behaviors were associated with personality traits, above and beyond the Big Five domains. Based on prior research in this area (Soutter et al., 2020) we expected that the domain of Openness would have the strongest association with pro-environmental behaviors, with somewhat weaker associations for the domains of Agreeableness, Conscientiousness, and Extraversion, and no significant association for the domain of Neuroticism. But we predicted that facet-level associations would vary within domains, although mostly in their strength rather than direction. Given the possibility that the associations of personality with pro-environmental behaviors are at least partly mediated by pro-environmental attitudes, we expected that the personality correlates of pro-environmental attitudes to be similar to pro-environmental behaviors in configuration, but stronger in magnitude. This is because attitudes are then more proximal to personality traits than behaviors. We examined the associations in two separate samples using somewhat different measures of pro-environmental behaviors, allowing us to cross-validate the findings.

Our second aim examined whether facet-level information provided a greater out-sample predictive ability of pro-environmental attitudes and behaviors, compared to domain-level information. For this, we trained the prediction model in one sample and applied it in the other to test the accuracy of the predictions.

2 | METHOD

Two existing datasets were used. For both, data collection had been approved by a research ethics committee and participants provided informed consent. Both datasets can be found as supplementary materials to this article on the Open Science Framework (https://osf.io/6c37n/?view_only=26cf482b7241440898e70a3f57ceb353; Soutter & Mõttus, 2020).

2.1 | Participants

The first dataset (Dataset A; Soutter & Mõttus, 2019) consisted of 501 participants, including 304 females (60.7%), 195 males (38.9%), and 2 "Other" gender choices (0.4%), with a mean age of 40.4 (SD = 12.3). Participants were exclusively from the United Kingdom and were recruited via the Prolific platform. Participants received financial compensation for their participation.

The second dataset (Dataset B; Soutter, Bates, & Mõttus, 2019) consisted of 287 participants, 207 females (72.1%), and 80 males (27.9%), with a mean age of 27.2 (SD = 11.2). Participants were recruited via Prolific, with financial compensation for their participation, or via a first-year psychology undergraduate sample pool, with course credit for their participation. Participants from the first-year psychology undergraduate sample pool were located in the United Kingdom; however, there was no restriction on location for the participants recruited via Prolific.

2.1.1 | Effect size and power

As mentioned in section 1.4 we expected similar effect sizes for domain-level associations, as those found in Soutter and colleagues (2020), and that facet-level associations would vary within domains, although mostly in their strength rather than direction. With some facets demonstrating stronger associations than their domains, and others weaker associations. We aimed to maximize statistical power and rigor through cross-validations across samples and by conducting a meta-analysis across our two samples. A post hoc power analysis revealed that with our combined sample (N = 788), using a critical α = .002, and a power of .80, we were able to detect correlations of r = .14.

2.2 | Measures

2.2.1 | Personality

Participants in both datasets completed a 120-item personality questionnaire from the International Personality Item Pool (IPIP-NEO-120; Johnson, 2014). This scale was designed to mimic the structure of the NEO-PI-R in measuring the Big Five domains as well as their 30 facets, using four items per facet.

2.2.2 | Pro-environmental attitudes

Participants in both datasets completed three pro-environmental attitudes measures. The New Ecological Paradigm (Dunlap, Van Liere, Mertig, & Jones, 2000), a 15-item measure, required participants to rate their agreement with items on a 5-point Likert scale with the responses 1 (*Strongly Disagree*), 2 (*Mildly Disagree*), 3 (*Unsure*), 4 (*Mildly Agree*), and 5 (*Strongly Agree*), α = .73 to .87. The Connectedness to Nature Scale (Mayer & Frantz, 2004), a 14-item measure, required participants to rate their agreement with items on a 5-point Likert Scale ranging from 1 (*Strongly disagree*) to 5 (*Strongly agree*), α = .84 to .88. The Environmentalism Scale (Soutter, 2020), a 38-item measure, required participants to rate their agreement with items on a 5-point Likert scale with the responses 1 (*Strongly Disagree*), 2 (*Somewhat Disagree*), 3 (*Neither agree nor disagree*), 4 (*Somewhat Agree*), and 5 (*Strongly Agree*), α = .93 to .96. These measures had all demonstrated good test-retest reliability (r = .55 to .86), internal consistency (α = .86 to .96), and predictive validity of pro-environmental behaviors (r = .41 to .56) in a previous study (Soutter, 2020).

2.2.3 | Pro-environmental behaviors

Participants in both datasets completed a donation measure (Soutter & Boag, 2019). Participants indicated how they would split $/£100 between three charities (one being an environmental charity), and the option of keeping the money for themselves.

In Dataset A the Pro-Environmental Behavior Scale (PEBS; Markle, 2013), a 19-item scale with four subscales (conservation, environmental citizenship, food, and transport), was used, α = .37 to .87. The original rating system was used, except that the driving question was given two additional responses. These were "I do not drive" (scored as the most environmental response) and "I do not know" (scored as the least environmental response). Last, the Environmental Behavior measure (EB), a 17-item measure, of which only 14 items were used due to a previous factor analysis (Soutter, 2020), was used. Participants rated how frequently they performed the presented behaviors on a 5-point Likert scale, with the responses of 1 (*Never*), 2 (*Sometimes*), 3 (*About half the time*), 4 (*Most of the time*), and 5 (*Always*), α = .81. The item that asked participants if they drove a fuel-efficient car had the additional option of 6 (*Do not own a car*; scored

as the most environmental response). In Dataset B participants completed a 10-item future behaviors measure (Soutter et al., 2019). In this measure, participants reported how likely they were to perform 10 behaviors in the future on a 5-point Likert scale with the responses of 1 (*Extremely unlikely*), 2 (*Somewhat unlikely*), 3 (*Neither likely nor unlikely*), 4 (*Somewhat likely*), and 5 (*Extremely likely*), $\alpha = .79$.

The PEBS had been shown to be a reliable and valid measure (Markle, 2013). The EB had demonstrated concurrent validity with existing measures of pro-environmental behaviors (Soutter, 2020), and in this study demonstrated concurrent validity with the four subscales of the PEBS ($r = .31$ to $.57$, $p < .001$). The donation measure demonstrated concurrent validity with the conservation and environmental citizenship subscales of the PEBS ($r = .19$ to $.22$, $p < .001$). Last, the future behaviors measure in Dataset B demonstrated concurrent validity with the donation measure ($r = .45$, $p < .001$).

2.3 | Statistical analyses

All analyses were completed in R version 3.6.1 (R Core Team, 20192019), and the script for these analyses can be found on the Open Science Framework (https://osf.io/6c37n/?view_only=26cf482b7241440898e70a3f57ceb353; Soutter & Mõttus, 2020). First, as we were concerned with how domains and facets were associated with pro-environmental attitudes and behaviors rather than individual scales (Mõttus, 2016), combined pro-environmental attitudes and behaviors scores were created, respectively. This was done by standardizing each of the pro-environmental attitudes (or behaviors) measures, and then taking an average of this to create a total pro-environmental attitudes (behaviors) score. This was done separately in each dataset.

To describe the associations between personality and pro-environmental attitudes and behaviors at a domain- and facet-level, correlations were calculated in each sample separately. To estimate the robustness of these findings, the associations between domains and pro-environmental attitudes in Dataset A were correlated with the associations between domains and pro-environmental attitudes in Dataset B ($N = 5$). This was repeated for pro-environmental behaviors, as well as for facet-level associations with both outcomes ($N = 30$). If the findings were consistent across datasets, meta-analytic associations would be calculated, with correlations weighted by the inverse of their standard errors combined; and we would focus our interpretations on the meta-analytic findings. In aggregate, this process would achieve our first aim of understanding if facet-level information provided a greater understanding, compared to domain-level information, of how personality traits were associated with pro-environmental attitudes and behaviors.

To achieve our second aim of understanding if facet-level information also provided a greater predictive ability of pro-environmental attitudes and behaviors, we performed two predictive analyses (Mõttus & Rozgonjuk, 2019). The first analysis multiplied the correlations between domains or facets and pro-environmental attitudes or behaviors calculated in one of the samples by the respective standardized personality scores (domains or facets) in the other sample, to create predicted (from domains or facets) pro-environmental attitudes or behaviors scores. These predicted scores were then correlated with actually measured pro-environmental attitudes and behaviors scores. This process was repeated swapping the samples around. The second analysis, used a more sophisticated but less tractable approach, were domains' and facets' predictive power for pro-environmental attitudes and behaviors were tested with linear elastic net regression via the *glmnet* package (Friedman, Hastie, Simon, & Tibshirani, 2019); both outcomes were linked with either domains or facets in one sample (with 10-fold cross-validation and shrinkage parameter that minimized prediction error) and the models were applied in the other sample to test their accuracy (i.e., correlations between predicted and observed outcome values).

3 | RESULTS

3.1 | Association patterns

The pattern of associations between domains and pro-environmental attitudes were consistent across datasets ($r = .97$, $p = .005$), as were the associations between facets and pro-environmental attitudes ($r = .83$, $p < .001$). Likewise, the pattern of associations between domains and pro-environmental behaviors were consistent across datasets ($r = .94$, $p = .018$), and the same applied to facets and pro-environmental behaviors ($r = .70$, $p < .001$). We also estimated the consistency of the effect sizes of facet-level associations across samples net of differences between the Big Five domains (subtracting the domain-wide average effect sizes from the facets' effect sizes; we did this because differences in domains were confounded with differences between facets in how they were correlated with pro-environmental attitudes and behaviors): the 30 facet-attitude associations correlated at $r = .62$, $p < .001$ across samples, whereas the facet-behavior associations correlated at $r = .47$, $p = .009$. Due to the relatively good replicability of the patterns of associations across datasets, meta-analytic associations were calculated for them and will be described below.

Pearson correlations between domains and pro-environmental attitudes and behaviors, and between facets and pro-environmental attitudes and behaviors can be found in Table 1, alongside the meta-analytic associations across our two samples. See Figures 1 and 2 for a summary of these meta-analytic associations. These correlations used a nominal

TABLE 1 Associations between personality domains, facets, and pro-environmental attitudes and behaviors

	Dataset A ($N = 501$)		Dataset B ($N = 287$)		Meta-analytic coefficients	
	Attitudes [95% CI]	Behaviors [95% CI]	Attitudes [95% CI]	Behaviors [95% CI]	Attitudes [*SE*]	Behaviors [*SE*]
D: Neuroticism	−.02 [−.10; .07]	−.11† [−.19; −.02]	.02 [−.10; .13]	−.05 [−.16; .07]	−.01 [.04]	−.09† [.04]
F: Anxiety	−.01 [−.10; .08]	−.10† [−.19; −.02]	.12† [.01; .24]	.03 [−.09; .14]	.04 [.04]	−.05 [.04]
F: Anger	−.06 [−.15; .03]	−.11† [−.20; −.02]	−.06 [−.18; .06]	−.08 [−.20; .03]	−.06 [.04]	-.10† [.04]
F: Depression	.00 [−.08; .09]	−.04 [−.13; .05]	.06 [−.06; .17]	.06 [−.06; .17]	.02 [.04]	−.00 [.04]
F: Self-consciousness	.03 [−.05; .12]	−.07 [−.15; .02]	−.02 [−.14; .09]	−.06 [−.18; .06]	.01 [.04]	−.07 [.04]
F: Immoderation	−.04 [−.13; .05]	−.14* [−.22; −.05]	−.04 [−.16; .07]	−.14† [−.25; −.02]	−.04 [.04]	−.14** [.04]
F: Vulnerability	−.00 [−.09; .09]	−.02 [−.11; .07]	.03 [−.08; .15]	−.02 [−.13; .10]	.01 [.04]	−.02 [.04]
D: Extraversion	.08 [−.01; .16]	.16** [.08; .25]	.02 [−.09; .14]	.04 [−.07; .16]	.06 [.04]	.12** [.04]
F: Friendliness	.03 [−.06; .11]	.12† [.03; .20]	.04 [−.08; .16]	.01 [−.11; .12]	.03 [.04]	.08† [.04]
F: Gregariousness	-.04 [−.12; .05]	.07 [−.01; .16]	−.03 [−.15; .08]	.00 [−.12; .12]	−.04 [.04]	.04 [.04]
F: Assertiveness	.01 [−.08; .10]	.06 [−.03; .14]	.05 [−.06; .17]	.06 [−.05; .18]	.02 [.04]	.06 [.04]
F: Activity level	.08 [−.01; .17]	.15** [.06; .23]	.07 [−.05; .19]	.13† [.01; .24]	.08† [.04]	.14** [.04]
F: Excitement seeking	.12† [.03; .20]	.14† [.05; .22]	−.04 [−.15; .08]	−.01 [−.13; .11]	.06 [.04]	.09† [.04]
F: Cheerfulness	.16** [.07; .24]	.18** [.10; .26]	.01 [−.10; .13]	.00 [−.11; .12]	.11† [.04]	.12* [.04]
D: Openness	.47** [.40; .53]	.40** [.33; .47]	.45** [.35; .54]	.26** [.15; .36]	.46** [.03]	.35** [.03]
F: Imagination	.26** [.18; .34]	.14† [.05; .22]	.20** [.08; .31]	.03 [−.08; .15]	.24** [.03]	.10† [.04]
F: Artistic interests	.41** [.33; .48]	.38** [.30; .45]	.39** [.28; .48]	.29** [.18; .39]	.40** [.03]	.35** [.03]
F: Emotionality	.29** [.20; .36]	.18** [.10; .27]	.35** [.24; .45]	.13† [.02; .25]	.31** [.03]	.16** [.04]
F: Adventurousness	.12† [.03; .20]	.19** [.11; .28]	.17† [.05; .28]	.20** [.09; .31]	.14** [.04]	.19** [.04]
F: Intellect	.33** [.25; .40]	.32** [.24; .40]	.33** [.22; .43]	.19* [.08; .30]	.33** [.03]	.27** [.03]
F: Liberalism	.36** [.29; .44]	.32** [.23; .39]	.17† [.05; .28]	.05 [−.07; .16]	.30** [.03]	.23** [.03]
D: Agreeableness	.34** [.26; .41]	.28** [.20; .36]	.33** [.23; .43]	.20** [.09; .31]	.34** [.03]	.25** [.03]
F: Trust	.09 [−.00; .17]	.14* [.05; .23]	−.05 [−.16; .07]	−.10 [−.22; .01]	.04 [.04]	.05 [.04]
F: Morality	.22** [.14; .31]	.16** [.08; .25]	.33** [.22; .43]	.21** [.10; .32]	.26** [.03]	.18** [.04]
F: Altruism	.35** [.27; .42]	.25** [.16; .33]	.33** [.23; .43]	.13† [.01; .24]	.34** [.03]	.21** [.03]
F: Cooperation	.17** [.08; .25]	.16** [.07; .24]	.17† [.06; .28]	.13† [.02; .24]	.17** [.04]	.15** [.04]
F: Modesty	.08 [−.00; .17]	.07 [−.01; .16]	.21** [.10; .32]	.18* [.07; .29]	.13** [.04]	.11* [.04]
F: Sympathy	.46** [.38; .52]	.35** [.27; .42]	.37** [.26; .46]	.24** [.13; .35]	.43** [.03]	.31** [.03]
D: Conscientiousness	.14* [.05; .23]	.18** [.09; .26]	.19* [.07; .29]	.17† [.06; .28]	.16** [.04]	.18** [.04]
F: Self-efficacy	.13† [.04; .22]	.14* [.05; .22]	.14† [.03; .26]	.09 [−.03; .20]	.13** [.04]	.12** [.04]
F: Orderliness	.07 [−.01; .16]	.14* [.06; .23]	.05 [−.07; .16]	.11 [−.01; .22]	.06 [.04]	.13** [.04]
F: Dutifulness	.18** [.10; .27]	.12† [.03; .20]	.15† [.04; .26]	.13† [.01; .24]	.17** [.04]	.12** [.04]
F: Achievement striving	.19** [.10; .27]	.20** [.12; .28]	.25** [.13; .35]	.20** [.08; .31]	.21** [.03]	.20** [.03]
F: Self-discipline	.08 [−.00; .17]	.15** [.07; .24]	.10 [−.01; .22]	.15† [.03; .26]	.09† [.04]	.15** [.04]
F: Cautiousness	−.03 [−.11; .06]	−.00 [−.09; .09]	.09 [−.03; .20]	.04 [−.07; .16]	.01 [.04]	.01 [.04]

Abbreviations: D, domain; F, facet.

$^{\dagger}p < .05$; $^{*}p < .002$; $^{**}p < .001$.

alpha of .002 for statistical significance to correct for multiple comparisons.

Among the domains, Openness was the most strongly associated with pro-environmental attitudes and behaviors ($r = .46$ and .35, respectively), followed by Agreeableness ($r = .34$ and .25, respectively), and Conscientiousness ($r = .16$ and .18, respectively). Extraversion was not significantly associated with pro-environmental attitudes ($r = .06$) but was

with pro-environmental behaviors ($r = .12$). Neuroticism was not significantly associated with pro-environmental attitudes and behaviors ($r = -.01$ and $-.09$, respectively).

Within Openness, all facets were positively associated with pro-environmental attitudes and behaviors, although the strengths of these associations varied considerably between facets ($r = .14$ to .40 and .16 to .35, respectively). The one exception to this was that Imagination was not significantly associated with pro-environmental behaviors. The facet of Artistic Interests was consistently the strongest facet associated with pro-environmental attitudes and behaviors ($r = .40$ and .35, respectively).

For the facets of Conscientiousness, all associations were positive, but there was variation among them. For example, Cautiousness was not significantly associated with pro-environmental attitudes and behaviors ($r = .01$). In contrast, Self-Efficacy, Dutifulness, and Achievement Striving were associated with both pro-environmental attitudes and behaviors ($r = .13$ to .21 and .12 to .20, respectively). Orderliness and Self-Discipline were only associated with pro-environmental behaviors ($r = .13$ and .15, respectively).

The Agreeableness' facets of Morality, Altruism, Cooperation, Modesty, and Sympathy were significantly associated with pro-environmental attitudes and behaviors, but the effect sizes varied ($r = .13$ to .43 and .11 to .31, respectively; the strongest correlations were for Sympathy). Trust was not associated with pro-environmental attitudes and behaviors ($r = .04$ and .05, respectively).

Last, Extraversion's and Neuroticism's facets tended to not be associated with pro-environmental attitudes and behaviors, with a few exceptions. Extraversion's facets of Activity Level and Cheerfulness were associated with pro-environmental behaviors ($r = .14$ and .12, respectively), and Neuroticism's facet of Immoderation was negatively associated with pro-environmental behaviors ($r = -.14$).

3.2 | Comparison of traits' associations with attitudes and behaviors

Hypothesizing that pro-environmental attitudes mediate personality traits' associations with pro-environmental behaviors, we expected (a) the profiles of the former and the latter to be similar and (b) the former (more proximate) associations to be, on average, stronger than the latter. Indeed, the profiles of facets' associations with pro-environmental attitudes and behaviors were similar ($r = .88$, $p < .001$), but the absolute values of the correlations were only marginally stronger on average for pro-environmental attitudes ($r = .14$) than for pro-environmental behaviors ($r = .13$). However, it is important to note that some associations differed in direction, but this was infrequent ($N = 5$) and only for nonsignificant associations.

3.3 | Correlations-based prediction

While these correlations provided a more detailed picture of how personality was associated with pro-environmental attitudes and behaviors, they did not fully account for the over-fitting of associations in individual samples and for

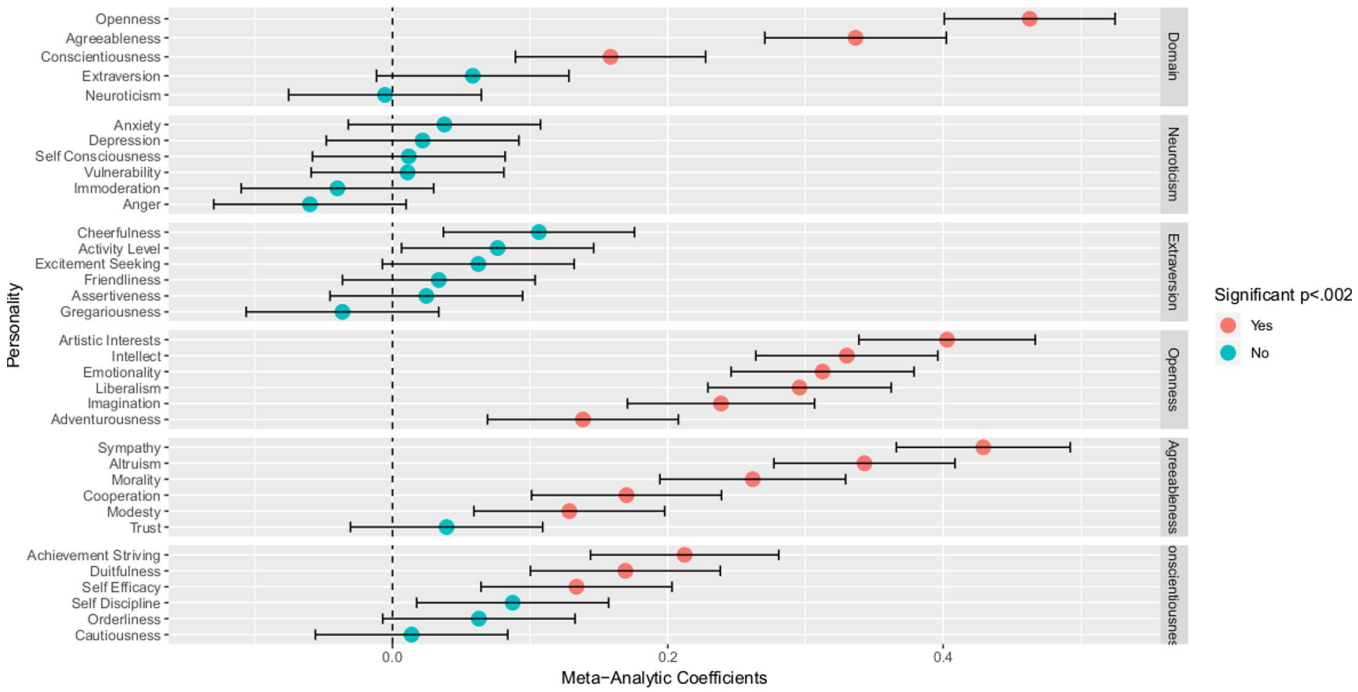

FIGURE 1 The meta-analytic associations between personality and pro-environmental attitudes

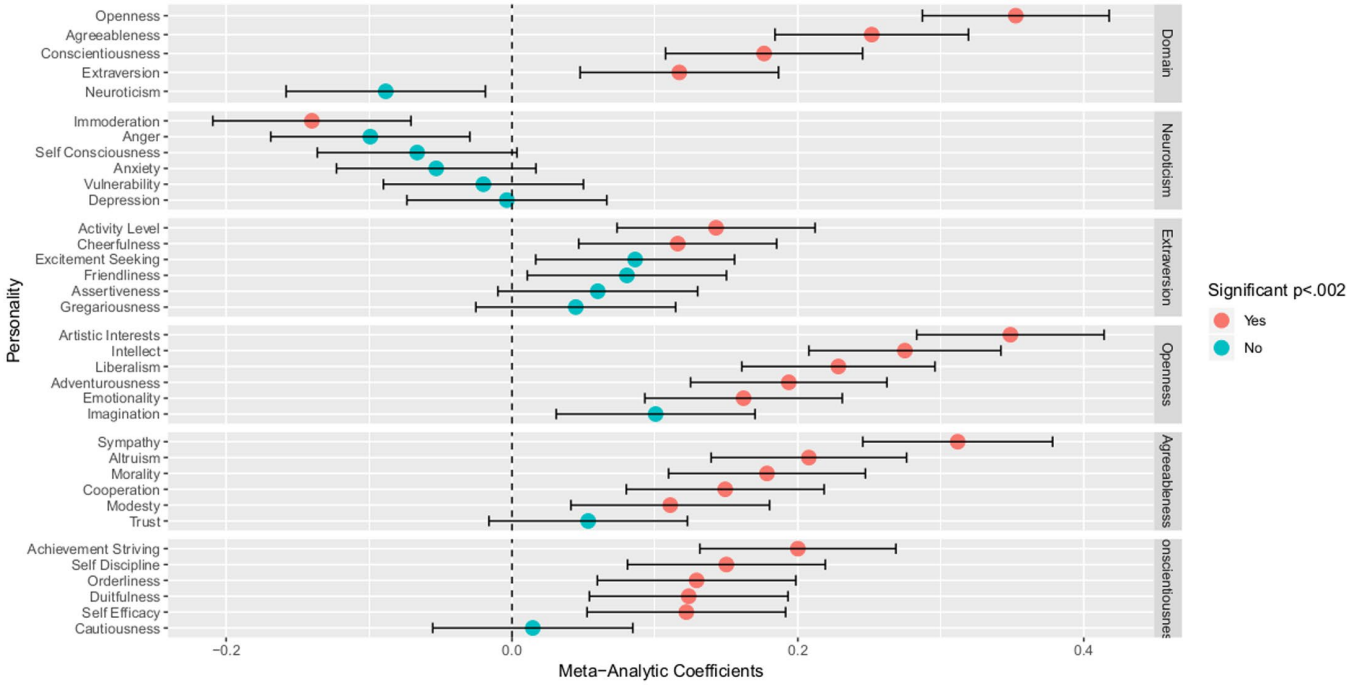

FIGURE 2 The meta-analytic associations between personality and pro-environmental behaviors

the overlaps between personality domains (and between facets), nor did they provide direct evidence of the predictive power of personality traits for outcomes (Yarkoni & Westfall, 2017). Thus, we directly examined the ability of personality domains and facets to predict pro-environmental attitudes and behaviors through the prediction analyses of "training" and "validation" models in independent datasets. This approach is standard in machine learning and had been shown to mitigate the potential effects of sampling biases, instrument biases, and some researcher degrees of freedom. Conceptually, this can be thought of as a very thorough test of the degree to which personality is associated with pro-environmental attitudes and behaviors.

The standardized domain scores, in Dataset B, were multiplied by corresponding domain correlations with either pro-environmental attitudes or behaviors (obtained from Dataset A) and subsequently summed, yielding predicted (from domains) pro-environmental attitudes and behaviors scores for each individual. These predicted scores were then correlated with the measured scores of pro-environmental attitudes and behaviors in Dataset B. This was repeated, swapping around the datasets. This was also completed for facets, replacing domains in the above steps.

It was found that the domain-level associations from Dataset A predicted pro-environmental attitudes ($r = .49$) and behaviors ($r = .28$) in Dataset B. The facet-level associations predicted pro-environmental attitudes ($r = .51$) and behaviors ($r = .29$). The domain-level associations from Dataset B predicted pro-environmental attitudes ($r = .50$) and behaviors ($r = .43$) in Dataset A. The facet-level associations predicted pro-environmental attitudes ($r = .50$) and behaviors ($r = .42$). All correlations were significant $p < .001$.

3.4 | Elastic net prediction

Dataset B contained fewer than 500 participants, which had been previously found to be the minimum required size for training via elastic net modeling (Mõttus & Rozgonjuk, 2019; Seeboth & Mõttus, 2018; Zou & Hastie, 2005). As a result, Dataset A was the "training" dataset and provided predicted pro-environmental attitudes and behaviors in Dataset B. It was found that the domain-level associations from Dataset A predicted pro-environmental attitudes ($r = .52$) and behaviors ($r = .31$) in Dataset B. The facet-level associations also predicted pro-environmental attitudes ($r = .52$) and behaviors ($r = .33$). All correlations were significant $p < .001$. Therefore, there was no evidence that facets provided incremental predictive ability over domains for either pro-environmental attitudes or behaviors, despite facets of the same domains often varying in their correlations with these outcomes.

4 | DISCUSSION

4.1 | Domains and pro-environmental attitudes and behaviors

We expected to find similar domain-level associations with pro-environmental attitudes and behaviors as found in

Soutter and colleagues (2020). This was mostly supported, as Openness was consistently and highly correlated with pro-environmental attitudes and behaviors, as were Agreeableness and Conscientiousness. Furthermore, Neuroticism was not associated with pro-environmental attitudes and behaviors. The inconsistency was that Extraversion was only associated with pro-environmental behaviors. However, the previous meta-analysis demonstrated that Extraversion had the weakest significant association with pro-environmental attitudes (Soutter et al., 2020). Thus, it might be due to this weak association that we did not replicate its association with pro-environmental attitudes in this study.

4.2 | Facets and pro-environmental attitudes and behaviors

We expected that describing personality traits at the facet-level would provide a more detailed picture of their associations with pro-environmental attitudes and behaviors. The correlations did, indeed, reveal a more detailed picture of these associations.

For Openness, although all its facets contributed to its positive association, the facet of Artistic Interests was consistently the strongest associate of pro-environmental attitudes and behaviors. This was in line with past research which had stated that aestheticism is particularly important for pro-environmental attitudes and behaviors (Markowitz et al., 2012). This facet had been argued to increase one's aesthetic appreciation of nature, which in turn motivates a desire to preserve nature (Hirsh & Dolderman, 2007). Intellect also had a comparatively strong association with pro-environmental attitudes and behaviors, which might be due to a greater understanding of the consequences humans have on the environment, which might result in a motivation to protect it. Liberalism was also comparatively strongly associated with pro-environmental attitudes and behaviors. Liberalism, in this context, is defined as a readiness to challenge authority, tradition, and convention (Johnson, 2020). This makes sense in light of environmentalism (think of Extinction Rebellion movement for an extreme example), which is often challenging the existing societal, political, and economic institutions that have contributed to the current ecological crises us, as humans, are facing. This builds upon earlier research which has suggested that unconventionality is only associated with pro-environmental attitudes, and not behaviors (Brick & Lewis, 2016). It might be that this association has altered through time, which could be reflected in the rise of worldwide movements to promote environmentalism (e.g., FridaysForFuture and Extinction Rebellion). Furthermore, it might be that the behaviors examined in this study were more in line with unconventionality as opposed to those behaviors examined by Brick and Lewis. For example, Dataset A included pro-environmental behaviors that assessed political support and protesting, whereas Brick and Lewis did not.

The facets of Agreeableness were generally associated with pro-environmental attitudes and behaviors in a positive direction, similarly to the domain. There was one exception to this, which was the facet of Trust, which was not associated with pro-environmental attitudes and behaviors. This lack of a relationship is interesting and should be probed in further research. For the other facets, Sympathy and Altruism had the strongest associations with pro-environmental attitudes and behaviors. This supported the idea that empathy and altruism are why people behave pro-environmentally (e.g., Schultz, 2001). This was also in line with past research that had suggested that facets like these were the reason why the domain of Agreeableness is associated with pro-environmental attitudes and behaviors (Markowitz et al., 2012). This makes sense as compassion and wanting to help others are needed to care for the environment, and subsequently help it. Morality and Cooperation also appeared to be associated with pro-environmental attitudes and behaviors; indeed, cooperating with others is needed to enact impactful environmental change and acting or wanting to protect those unable to help themselves (i.e., the environment) is an obvious moral goal.

The facets of Conscientiousness were also positively associated with pro-environmental attitudes and behaviors, but in a more sporadic pattern than Agreeableness' facets. Cautiousness was consistently not associated with pro-environmental attitudes and behaviors, while Self-Efficacy, Dutifulness, and Achievement Striving were consistently associated with them. Cautiousness is defined as one's disposition to think through possibilities before acting (Johnson, 2020). Thus, its lack of an association suggested that acting pro-environmentally can appeal to both those who do (not) think through their actions. Therefore, regardless of one's approach to tasks, regarding thinking through it, people can behave and think pro-environmentally. Self-Efficacy, Dutifulness, and Achievement Striving were all consistently associated with pro-environmental attitudes and behaviors, which suggested that pro-environmental individuals were goal-driven and persevere with tasks. This makes sense in the context of pro-environmental attitudes and behaviors, as combating or reducing environmental impact is a large task, which would require a desire to continue over time and situations despite setbacks, and a belief that one could do so. Interestingly Self-Discipline was only positively associated with pro-environmental behaviors. This might suggest that self-discipline is only needed to continuously perform pro-environmental behaviors and that it is not necessary for pro-environmental attitudes. However, greater research is needed into why Self-Discipline was not associated with pro-environmental attitudes.

For Extraversion, only the facets of Activity Level and Cheerfulness were significantly associated with

pro-environmental behaviors. These findings suggested that certain pro-environmental behaviors involve or are compatible with a high level of stimulation that are perhaps enjoyable, but that this does not necessarily translate to fostering more pro-environmental attitudes in people. It might be the case the individuals high in these facets engage more with outdoor activities (e.g., sports or hiking) and that this active engagement with the natural environment leads to pro-environmental behaviors.

Last, for Neuroticism the only significant result was Immoderation being negatively associated with pro-environmental behaviors. Johnson (2020) described individuals high in Immoderation as being orientated toward short-term pleasures, rather than long-term consequences. As pro-environmental behaviors often involve making sacrifices or require extra effort in the short term, to avoid a long-term consequence, it is thus logical that individuals who are orientated to avoid these short-term consequences would act un-environmentally. This provided greater insight into Neuroticism's association with pro-environmental attitudes and behaviors, which was hidden when looking at domain-level associations, which demonstrated a lack of a relationship between Neuroticism and pro-environmental attitudes and behaviors in a recent meta-analysis (Soutter et al., 2020) and here.

4.3 | On predictions

This study also aimed to examine whether this greater knowledge of facet-level associations with pro-environmental attitudes and behaviors would translate into a greater predictive ability. Two types of predictive modeling were performed, and across both, it was found that facet-level predictions were on par with domain-level predictions. The domain-level predictions were in a similar range to those found in Soutter and colleagues (2020). The facet-level predictions were also comparable to those found by Soutter and colleagues for domains. This evidence suggested that despite facet-level information having provided a greater understanding of personality's associations with pro-environmental attitudes and behaviors, this did not translate into a greater out-of-sample predictive ability. This was in contrast with other findings in the literature regarding other outcomes (e.g., Elleman, Condon et al., 2020; Elleman, McDougald et al., 2020; Mõttus & Rozgonjuk, 2019).

One reason for this might be that that the domain-level predictions were already quite high, thus any marginal facet differences may not translate to better predictions; unlike for many other outcomes (e.g., Mõttus, 2016). Another reason may be that our samples were not sufficiently large to yield stable enough training models for out-sample prediction; with larger samples, some gains in facet-level prediction over domain-level prediction might be possible, although our current findings suggested that the gains would unlikely be huge.

4.4 | Limitations and generalizability

While this study demonstrated that facets provided greater information on personality's associations with pro-environmental attitudes and behaviors and provided substantial predictive accuracy for these attitudes and behaviors, there were several issues that might have impacted the generalizability of these findings. First, the pool of facets we examined was solely from the IPIP-NEO-120. While having a consistent measure of personality across datasets is useful for analytical purposes, it is a restriction of the possible facets examined. For one it restricted facets to just the Big Five and ignored the facets of the HEXACO model of personality. Thus, this study could only make claims about the Big Five facets, and not those of the HEXACO. Furthermore, the number and type of facets for each domain are not consistent and changes between measures of the Big Five (DeYoung, 2014). Future research should collect data from a wider set of personality measures to better understand if these facet-level associations are consistent across the Big Five and HEXACO, at least for similarly named facets, and whether this present study missed any important facets that could be associated with pro-environmental attitudes and behaviors. Also, future research should consider narrower-still personality traits, nuances (McCrae, 2015; Mõttus, 2016; Mõttus, Kandler, Bleidorn, Riemann, & McCrae, 2017; Mõttus et al., 2019), which often provide the strongest predictive power (e.g., Elleman, Condon et al., 2020; Elleman, McDougald et al., 2020; Seeboth & Mõttus, 2018).

Second, there were potential issues with our samples. Both datasets relied on internet recruitment, with Dataset B also including first-year undergraduate students. Thus, the samples we assessed here were unlikely to be representative of the general population. For example, our samples were predominantly female and skewed toward a younger age. Furthermore, although data on education was not collected for Dataset A, 81.1% of our sample in Dataset B had at least some higher education, thus even if everyone in Dataset A had no higher education over half our total sample had some higher education. Lastly, the study was restricted to those who had access to the internet and time to complete an online survey. Thus, there might be some limit to the generalizability of these findings to the general population. Furthermore, our sample sizes were relatively small; this was especially an issue for predictive modeling. Due to low sample sizes, we were unable to consider personality nuances, which had been shown to provide even greater information on associations than facet-level analysis (e.g., Mõttus & Rozgonjuk, 2019).

Last, the datasets used within these studies exclusively focused on self-report measures of pro-environmental behaviors. While this is a common method of assessment regarding pro-environmental behaviors (Steg & Vlek, 2009), there are some questions regarding the validity of these self-reports (Gifford, 2014; Lange, Steinke, & Dewitte, 2018). A meta-analysis had found a large association between self-reported and actual objective pro-environmental behaviors ($r = .46$), but it was argued that this is functionally small (Kormos & Gifford, 2014). Thus, if researchers wish for their work to have a practical application in addressing humanity's impact on the natural environment, a greater focus on actual objective pro-environmental behaviors is required. For a review on measuring pro-environmental behaviors see Lange and Dewitte (2019).

4.5 | Going forward

As research in understanding how facets are associated with pro-environmental attitudes and behaviors is in its infancy the weaknesses of this study were to be expected, and greater research will be needed in this area. However, this study provided an exploratory insight into whether facets provided a greater understanding of personality's association with pro-environmental attitudes and behaviors. Unlike domain-level research, facet-level research in this field is very limited, with a literature search, and the results of Soutter and colleagues (2020) having revealed only six studies that examined facet-level associations explicitly. While some studies might have been missed, this is clearly a fraction of the research done at a domain-level (59 studies identified in Soutter et al., 2020). Furthermore, of these studies, none had attempted to examine whether facets predicted pro-environmental attitudes and behaviors, or if it did this to a greater extent than domains.

While more research in this area is needed, a greater understanding of what facets drive domain-level associations can provide valuable insight into tailoring successful interventions. For example, this study demonstrated that Agreeableness as a domain was positively associated with pro-environmental attitudes and behaviors. Within this domain, Sympathy and Altruism were the primary drivers of this association. Thus, as individuals low in these facets are unlikely to engage in pro-environmental behaviors, interventions should not attempt to motivate action through compassionate means. Instead, campaigns should attempt to motivate action through focusing on the direct benefits of acting pro-environmentally (e.g., reduction in electricity bills or schemes that financially reward recycling e.g., bottle return schemes), as it is likely individuals who are compassionate are already acting environmentally, and those who are low in these traits are unlikely to be swayed by interventions that use these motivations.

4.6 | Conclusion

In conclusion, this study examined whether facets, over the Big Five domains, provided a greater understanding of personality traits' associations with pro-environmental attitudes and behaviors. We found that examining personality at a facet-level provided information on which facets were the strongest contributors to domains' associations with pro-environmental attitudes and behaviors. Furthermore, the data suggested that facet-level information provided equal predictive ability to that of domain-level information. While this study had several limitations, it provided a useful start to research on better understanding of personality's association with pro-environmental attitudes and behaviors.

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CONFLICT OF INTERESTS

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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5.2 Chapter Conclusion

In this chapter we performed an analysis of how the Big Five facets were associated with pro-environmental attitudes and behaviours. Using two datasets, we initially performed a correlational analysis that assessed how the domains, and the facets within them, were associated with pro-environmental attitudes and behaviours. The patterns of these associations were then compared. It was found that the pattern of associations between domains and pro-environmental attitudes and behaviours were consistent across datasets; as were the pattern of associations between facets and pro-environmental attitudes and behaviours. We subsequently conducted a meta-analysis of these associations using the two datasets. The results of this meta-analysis demonstrated that facet-level associations, compared to domain-level associations, provided a greater understanding of personality's associations with pro-environmental attitudes and behaviours. It was found that certain facets within domains were the main drivers of domain-level associations. For example, amongst the facets of Openness, Artistic Interests had the strongest associations with pro-environmental attitudes and behaviours. Furthermore, this analysis found that while some facets within a domain may not be associated with pro-environmental attitudes and behaviours, within no domain were facets associated in contradictory patterns (i.e. positively and negatively associated).

In this chapter we focused on the individual significance of facet-level associations, and their magnitudes, when discussing which facets appeared to drive domain-level associations. However, we did not statistically compare the differences between facet-level associations within domains. To do so would require *r* to *Z* transformations and to perform *Z*-tests to assess whether the correlations statistically differed from each other. A supplementary analysis (see Appendix C.1) was performed to assess whether there were within-domain differences between facet-level associations with pro-environmental attitudes and behaviours.

Regarding Openness, it was stated that the facet of Artistic Interests had the strongest associations with pro-environmental attitudes and behaviours. This supplementary analysis revealed for pro-environmental attitudes Artistic Interests was significantly different to Imagination and Adventurousness, but not Emotionality, Intellect, and Liberalism. For pro-environmental behaviours it was significantly different to Imagination, Emotionality, Adventurousness, and Liberalism. Thus, while in absolute magnitude Artistic Interests had the strongest associations, amongst the facets of Openness, with pro-environmental attitudes and behaviours it was not always statistically so. This might seem problematic for our suggestion then to focus on Artistic Interests when designing interventions. However, this is not necessarily a problem. This is because there would be no downside to focusing on Artistic Interests, say over Intellect, because there were no significant differences in their associations with pro-environmental attitudes and behaviours. Thus, focusing on Artistic Interests over Intellect would be arbitrary, and in such a case there is no reason not to focus on the one with the strongest absolute correlation (even if it is not statistically stronger).

In addition to these analyses we examined whether these facet-level associations could, collectively, predict pro-environmental attitudes and behaviours. Furthermore, we examined if this predictive ability would be greater than that provided by domain-level associations. Using methods from machine learning (Yarkoni & Westfall, 2017) we conducted two predictive analyses (Mõttus & Rozgonjuk, 2019). The first used a simple and tractable approach, testing prediction via zero-order correlations. The second used a more sophisticated but less tractable approach that employed linear elastic net regressions. These prediction analyses demonstrated that facets, collectively, provided substantial predictive ability for pro-environmental attitudes (r = .50 to .52) and behaviours (r = .29 to .42). Facets were able to accurately predict pro-environmental attitudes and behaviours but provided no additional predictive ability over domain-level associations.

This greater understanding of how personality traits were associated with an outcome when examined at a narrower level, was consistent with research in other areas, such as obesity and age (Mõttus & Rozgonjuk, 2019; Vainik et al., 2019). However, the lack of incremental predictive ability was not consistent with this research in other areas. This was not necessarily a negative, as it demonstrated that focusing on facets provided additional understanding of personality's associations with pro-environmental attitudes and behaviours, without decreasing the ability to predict these attitudes and behaviours from personality traits.

Although further research should be conducted, the findings of this study demonstrated that specific facets within domains tended to drive personality's associations with pro-environmental attitudes and behaviours. This could have practical implications for interventions that wish to incorporate personality traits to promote pro-environmental attitudes and behaviours. For example, in this chapter it was found that within Agreeableness, the facets of Sympathy and Altruism were the primary drivers of Agreeableness' associations with pro-environmental attitudes and behaviours. Thus, effective interventions could focus their design by taking into account these facets specifically, rather than all the facets if only domain-level information was used. Effective interventions could incorporate this information by reducing their focus on empathic and compassionate motivations for acting pro-environmentally. Instead they could focus on the personal benefits of acting pro-environmentally, for example by highlighting the cost savings of electricity and water usage reductions or by providing incentives for pro-environmental behaviours (e.g. bottle return schemes). This would be more effective, as individuals who are high in facets like Sympathy and Altruism would likely be already engaged in pro-environmental behaviours, and those low in these facets would be unlikely to be swayed by messages that promote empathy and compassion.

Future research should further explore facet-level associations with pro-environmental attitudes and behaviours. In this chapter several directions for this future research were discussed. These included an expansion of the facets and personality models (i.e. HEXACO) examined and for future studies to focus on actual observable pro-environmental behaviours. Lastly, studies should attempt to assess potential mechanisms for promoting pro-environmental attitudes and behaviours that take into account individual differences. In the next part of this dissertation we continued our examination of how individual differences were associated with pro-environmental attitudes and behaviours. This was done by examining the individual difference of political preferences. Furthermore, we examined the effectiveness of a potential mechanism (i.e. question wording) for promoting pro-environmental attitudes and behaviours and how it interacted with political preferences.

Part 3: On Political Preferences and Pro-Environmental Attitudes and Behaviours

Part 2 and 3 of this dissertation examined how individual differences were associated with pro-environmental attitudes and behaviours. In Part 2 we examined personality's associations with pro-environmental attitudes and behaviours. In Part 3 we shifted our examination to the individual difference of political preferences, and how they were associated with pro-environmental beliefs, attitudes, and behaviours. Political preferences had been found to be generally associated with pro-environmental beliefs, attitudes, and behaviours in past studies (Allen et al., 2007; Azarova et al., 2019; Brick & Lewis, 2016; Cruz, 2017). An example of this is how political preferences were associated with beliefs in environmental issues, such as climate change and global warming (Pew, 2015, 2017). Research had examined how these pro-environmental beliefs were impacted by political preferences and the environmental terminology used (i.e. climate change versus global warming; Schuldt et al., 2011, 2015, 2017). This research suggested that political preferences had an interactive effect with the environmental terminology used (i.e. question wording) on altering beliefs in environmental issues. Specifically, Republicans believed more in climate change than in global warming, and Democrats believed in both equally, and to a greater extent than Republicans (Schuldt et al., 2011, 2015, 2017). However, the findings of some studies suggested that the universal replicability of this effect may be limited (Dunlap, 2014; Villar & Krosnick, 2011).

In the following chapters we examined the influence of political preferences on pro-environmental beliefs, attitudes, and behaviours, and their potential use for informing effective interventions aimed at promoting these beliefs, attitudes, and behaviours. Two studies were conducted simultaneously. In Chapter 6 we performed a pre-registered large cross-country replication of a study conducted by Schuldt and colleagues (2011). In this chapter we assessed whether the interactive effect between political preferences and question wording on climate change/global warming beliefs was still present in the original context of

the USA. Furthermore, we assessed whether this effect could be extended to the UK and Australia. In Chapter 7 we instead examined whether alterations to the operationalisations of political preferences, would alter the findings of Schuldt and colleagues. Furthermore, we examined how political preferences were associated with a wide range of pro-environmental attitudes and behaviours. Lastly, we examined whether these effects and associations remained when controlling for personality traits.

Thus, to summarise. Two studies were conducted simultaneously. In the first study, reported in Chapter 6, we conducted a direct replication of Schuldt and colleagues (2011) and expanded it two other countries. This chapter examined whether one could directly replicate the original finding in its original context and two other countries. In the second study, reported in Chapter 7, we conducted a conceptual replication of Schuldt and colleagues. This chapter examined if alterations to how political preferences were operationalised and controlling for personality traits would alter the findings of Schuldt and colleagues. Furthermore, we aimed to examine how political preferences, controlling for personality traits, were associated with pro-environmental attitudes and behaviours.

Chapter 6: “Global Warming” Versus “Climate Change”: A Replication on the Associations between Political Self-Identification, Question Wording, and Pro-Environmental Beliefs

6.1 Chapter Introduction

There is a widespread consensus amongst scientists, which is supported by a wealth of scientific evidence, that climate change and global warming are not only real, but amongst the greatest threats of our time (Cook et al., 2016; Hilbig et al., 2013; Intergovernmental Panel on Climate Change, 2018; Klein et al., 2017; Nisbet et al., 2009; Otto et al., 2014; United Nations Environment Programme, 2019). Despite this, scepticism towards these phenomena still exists (Pew, 2015, 2017). Several factors had been found to be associated with beliefs in these phenomena. For instance, beliefs in climate change varies between countries. For example, 41.0% of Americans believed that climate change was harming people now, compared to 56.0% of Canadians, or 90.0% of Brazilians (Pew, 2015). Gender differences in these beliefs were found, with women believing more than men that personal changes were needed to combat climate change (Pew, 2015). Education was associated with whether one sees climate change as a major threat, with greater levels of education being associated with higher levels of beliefs that climate change was a major threat (Fagan & Huang, 2019). Political preferences were also found to be associated with beliefs in climate change and global warming. This was not surprising, as political preferences had been associated with pro-environmental attitudes and behaviours to various degrees (Allen et al., 2007; Azarova et al., 2019; Brick & Lewis, 2016; Cruz, 2017).

The political polarisation of beliefs in climate change and global warming was perhaps most pronounced in the USA. A survey in 2015 found a 48 percentage point difference between Republicans (20.0%) and Democrats (68.0%), on whether global climate change was a very serious problem. Furthermore, a 29 percentage point difference between Republicans (24.0%) and Democrats (53.0%), on whether climate change was harming people now, was found (Pew, 2015). Similar results were found regarding global warming. When asked if there was solid evidence that the average temperature on Earth was getting

warmer, a 40 percentage point difference between Republicans/lean Republican (52.0%) and Democrats/lean Democrat (92.0%) was found (Pew, 2017). This political polarisation was not only bound to the USA. For example, in the UK a 10 percentage point difference was found between Conservatives (39.0%) and Labour (49.0%), and a 34 percentage point difference in Australia between Liberals (Australian Conservatives; 31.0%) and Labor (65.0%), on whether climate change will personally harm them (Pew, 2015). This political polarisation in beliefs was found to translate into support for pro-environmental policies. For example, there was a 41 percentage point difference between Republicans/lean Republican (36.0%) and Democrats/lean Democrat (77.0%) regarding the idea that stricter environmental laws and regulations were worth the cost (Pew, 2017). Similarly, there was a 32 percentage point difference between Republicans (50.0%) and Democrats (82.0%) regarding support for limiting greenhouse gas emissions (Pew, 2015). While beliefs in these environmental phenomena are increasing generally around the world (Fagan & Huang, 2019), this has been accompanied by a growing political polarisation of beliefs in these environmental phenomena (Brenan & Saad, 2018; Fagan & Huang, 2019; Pew, 2017). This is problematic because effective environmental action requires cross-party support.

One study that examined why political polarisation in environmental issues exists examined the use of terminology (Schuldt et al., 2011). It was found that the term climate change, as opposed to global warming, decreased the difference in beliefs between Republicans and Democrats. Specifically, there was a 42.9 percentage point difference between Republicans (44.0%) and Democrats (86.9%) regarding beliefs in global warming, which was reduced to a 26.2 percentage point difference between Republicans (60.2%) and Democrats (86.4%) regarding beliefs in climate change. This effect had been replicated by Schuldt and colleagues (2015, 2017). However, the results of some studies suggested that the universal replicability of this effect was limited (Dunlap, 2014; Villar & Krosnick, 2011).

The potential limitations of the universal replicability of this effect, and the growing political polarisation of beliefs in global warming and climate change motivated us to perform a direct replication of the study conducted by Schuldt and colleagues (2011). Furthermore, to our knowledge no other study had attempted previously to directly replicate Schuldt and colleagues in other countries. Thus, we aimed to extend our replication to two other countries the UK and Australia. The study reported in Chapter 6 examined whether the effect found by Schuldt and colleagues could be independently replicated, as well as whether this effect could be found in two other countries.

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"Global warming" versus "climate change": A replication on the association between political self-identification, question wording, and environmental beliefs

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ABSTRACT

Climate change is one of the greatest threats to humanity and requires immediate action. Schuldt, Konrath, and Schwarz (2011) suggested that beliefs in environmental phenomena can be influenced by the terminology used to describe it: changing question wording from global warming to climate change resulted in a 6.3 percentage point increase in belief in environmental phenomena. This association was moderated by political self-identification, with Republicans being 16.2 percentage points more likely to believe in climate change than in global warming, with Democrats showing no difference. The potential for connotative meanings to shift over time and the sociopolitical changes since the original study, potential policy and environmental campaign implications, and an expansion of these findings to other countries, motivated an attempt to replicate this important finding. This pre-registered study repeated the original procedures in the United States of America and two other countries (United Kingdom and Australia; total N = 5,717). Although question wording no longer had a significant effect on beliefs in climate change/global warming, the association of political self-identification with beliefs in environmental phenomena replicated in all three countries, with Conservatives consistently believing less in climate change/global warming than Liberals. The potential impacts of temporal and methodological differences on the discrepancies between this study's and the original's findings are discussed.

1. Introduction

Consistent with a wealth of scientific evidence, it is a shared belief among many scientists that anthropogenic climate change is one of the greatest threats of our time (Hilbig, Zettler, Moshagen, & Heydasch, 2013; Intergovernmental Panel on Climate Change, 2018; Klein, Hilbig, & Heck, 2017; Nisbet, Zelenski, & Murphy, 2009; Otto, Kaiser, & Arnold, 2014; Poškus & Žukauskienė, 2017; United Nations Environment Programme, 2019). Despite this, scepticism remains high, with only 45.0% of Americans, 41.0% of British, 43.0% of Australians, 19.0% of Chinese, and 29.0% of Israelis believing that climate change is a very serious problem (Pew, 2015). Furthermore, Australia and the United States of America (USA) have both recently elected political leaders, who have been criticised for their climate change views, Scott Morrison (e.g., Doran, 2019; The Guardian, 2017, 2018) and Donald Trump (e.g., Borger, 2017; British Broadcasting Corporation, 2018, 2019). Furthermore, Donald Trump has consistently called global warming a hoax (e.g., Trump, 2013; 2017), and by extension climate change, which he has consistently called a rebranding of global warming (e.g., Trump, 2014a, 2015). With the growing urgency of climate change, there is a need for an urgent solution, but agreeing on a solution may be complicated by widespread public scepticism and the issue being heavily politicised. It is therefore vital to understand what motivates one's (dis)belief in environmental issues like climate change and global warming (McCright, Charters, Dentzman, & Dietz, 2016; Pew, 2015; Poortinga, Spence, Whitmarsh, Capstick, & Pidgeon, 2011; Tranter, 2011).

In 2002, a memo was written by Frank Luntz for the Republican Party on how to address environmental issues (Luntz, 2002). Luntz suggested that Republicans should update their terminology when discussing the environment, by describing themselves as conservationists, rather than preservationists or environmentalists, as the former had more positive connotations. Secondly, he suggested that Republicans use the term climate change instead of global warming, as the latter was deemed less controllable, more catastrophic, and more emotionally challenging. It was suggested that these simple changes in

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terminology would assist the Republicans in winning the environmental debate. This latter claim has undergone research scrutiny, specifically whether there really is a difference in opinion over climate change and global warming. A study by Schuldt, Konrath, and Schwarz (2011) is one such study.

1.1. The original study

Schuldt et al. (2011) performed an experiment in the USA in which participants were presented with one of two vignettes and asked if they believed in the environmental phenomenon presented in the vignette. The vignettes were nearly identical, apart from two minor changes to question wording:

You may have heard about the idea that the world's temperature may have been *going up* [*changing*] over the past 100 years, a phenomenon sometimes called '*global warming*' [*'climate change'*]. What is your personal opinion regarding whether or not this has been happening?

Schuldt et al. (2011) compared the differences in belief and found that 75.0% of Americans expressed belief in climate change, but only 67.7% for global warming, a significant difference of 6.3 percentage points. Furthermore, the role of political self-identification in belief was examined, with political self-identification grouped as either Republican, Democrat, Independent, or Other/None of the above. It was found that Republicans drove this wording effect, with a 16.2 percentage point difference in belief depending on whether the question referred to climate change (60.2%) or global warming (44.0%), with no significant differences for the other political groups. Although not an explicitly stated implication of their study, this difference could potentially suggest a behavioural change through a cost-efficient intervention: by simply updating environmental campaigns and policy to mention climate change rather than global warming. Further research has been conducted in this area, although no direct replication has been attempted.

1.2. Further studies

A similar study, conducted during the same time period, examined the impact question wording had on perceptions of belief (Villar & Krosnick, 2011). Similar to Schuldt et al. (2011), participants were separated into different question wording groups, global warming or climate change, and an added third condition of global climate change. Participants rated how serious of a problem the phenomenon presented would be. No overall difference in the perceived seriousness of the problem was found across all three wording conditions. Furthermore, there was no significant moderation of political self-identification on question wording and belief.

A European study (Villar & Krosnick, 2011) with a comparable design reported mixed findings. Participants were asked to rank the seriousness of climate change and global warming, and tended to rank climate change as a bigger problem. However, when asked on a Likert-type scale about the seriousness of the issue, no differences were found between climate change and global warming. Political self-identification did not moderate the effect of question wording on how serious the problem was considered regardless of question format. Lastly, most countries did not moderate the effect of question wording. For the ranked scale, participants in 23 of the 31 examined countries (Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Finland, Greece, Hungary, Ireland, Italy, Latvia, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Turkey, United Kingdom, and the Former Yugoslav Republic of Macedonia) showed no difference between climate change and global warming; participants in six countries (Spain, Sweden, Estonia, Lithuania, Denmark, and Germany) were less likely to mention global warming as a serious problem and participants in two countries (France and Turkish Cypriot Community) showed the opposite trend. For the Likert-type question, participants in 28 of the 31 countries examined showed no difference between climate change and global warming; those in two countries (Slovakia and the Netherlands) tended to rate climate change as more serious, and in the United Kingdom (UK) the opposite trend emerged. A study conducted a few years later also found no effect of question wording on how serious climate change/global warming was considered, and found no interaction between political self-identification and question wording on the perceived seriousness of these issues (Dunlap, 2014).

These two studies suggest that the findings of Schuldt et al. (2011) may not be universally replicable. However, they differed from the original study in that they examined problem seriousness, not belief in the existence of the problem. Although this might seem like a minor difference, problem seriousness and belief in the existence of the problem refer to only partly overlapping concepts (Krosnick, Holbrook, Lowe, & Visser, 2006; Schuldt, Enns, & Cavaliere, 2017). A few other studies though have examined belief in the existence of the problem, as opposed to problem seriousness.

Schuldt, Roh, and Schwarz (2015) expanded upon the original study (Schuldt et al., 2011) by examining the impact of question wording, on people's belief about the scientific consensus on the issue presented, and also people's support for green legislation. They replicated the original findings pertaining to the effects of question wording and its interaction with political self-identification on beliefs in climate change versus global warming. Although this study examined party self-identification on a more nuanced spectrum, it was collapsed into the same categories as the original (Democrat and Republican) and did not include the categories of Independent and Other; a later study reanalysed these data using the more nuanced political self-identification measure and also replicated the findings (Morin-Chassé & Lachapelle, 2019). This reanalysis found that Republicans with strong political self-identification demonstrated lower levels of belief in both global warming and climate change, compared to all other self-identification categories, including more moderate Republicans. Furthermore, there was a stronger belief in climate change than in global warming for "strong Republicans", "Republican leaners", and "Democrat leaners".

Schuldt et al. (2017) attempted to further replicate the original findings (Schuldt et al., 2011) with a more simplified question wording task. This simplified question wording task was: "Do you believe *global warming* [*climate change*] is really happening?", with the responses of "Yes, definitely", "Yes, somewhat", and "No". Party self-identification was measured on a spectrum that was collapsed into Republicans, Democrats, and Independents/Others. Despite the more simplified question wording task, the effect of question wording and its interaction with party self-identification on belief in climate change/global warming was found. Lastly, a report containing two nationally representative surveys within the USA found that the American public perceived the two terms, global warming and climate change, differently on several different aspects (Leiserowitz et al., 2014). Generally speaking, global warming appeared to be more engaging than climate change and involved a greater sense of certainty and negativity.

1.3. Importance of findings and policy

Although further research in this area has been conducted, including replications by Schuldt et al. (2015 and 2017), and work is continuing (e.g., Jones & Whitmarsh, 2019), to our knowledge no study, by authors other than those of the original study, has attempted to directly replicate the findings. However, it is important to note that Schuldt and colleagues have attempted to replicate their own work, with some success. Furthermore, Schuldt and colleagues, have worked alongside leading survey data firms (i.e., RAND Corporation and GfK/Knowledge Networks) and their data have been archived for other researchers to use (e.g., Morin-Chassé & Lachapelle, 2019). Despite this work by the original authors to apply rigours scientific practices, independent replication of effects is beneficial for good research practice (Francis, 2012; Frank & Saxe, 2012; Open Science Collaboration, 2015).

Furthermore, there are several reasons why the findings of Schuldt et al. (2011) should be probed for their robustness.

Firstly, research in this area has demonstrated that small differences in how a study is conducted (e.g., problem seriousness versus problem existence) can impact results. Secondly, although not directly stated as an implication in the original study, these findings indicate the possibility for a large behavioural change requiring little intervention. This could have major repercussions for effective environmental policy interventions not only in the USA but elsewhere too. Tapping into the observed effect of a 16.2 percentage point difference in the belief in climate change versus global warming amongst individuals, who are often cited as being the least likely to believe in climate change or global warming (Pew, 2015), could be a major boon for environmental campaigns worldwide — but only if the effect is indeed robust across sociocultural contexts.

The potential policy and environmental campaign implications are sufficient to merit the replication of these results, but an expansion of these findings into other countries is also of vital importance. To tackle a global issue like climate change, a global response is needed. Earlier work in the UK on the differences between beliefs on climate change and global warming revealed that there were important qualitative and quantitative differences in how the public understood these two terms (Whitmarsh, 2009). It was found that global warming was more often associated with heat-related impacts, ozone depletion, greenhouse effect, and human causes. In contrast, climate change was more often associated with a wider range of impacts (e.g., wetter winters, increased drought, impacts on food supply), impacts that have already been observed, and natural causes. This was also reflected quantitatively with 27.9% of people believing that climate change was just a natural fluctuation in earth's temperature whereas only 16.0% felt that way for global warming ($p < .01$). Furthermore, another study found that people in the UK tended to rate global warming as more serious than climate change (Villar & Krosnick, 2011). Global warming and climate change are technically two distinct topics (Schuldt et al., 2017), however, public discourse often uses them interchangeably, with only 4.0% of people explicitly indicating differences between the two (Whitmarsh, 2009). This formed the second motivation and expansion of this replication to the UK: to examine whether these differences were driven by widespread political partisanship similar to the USA.

Another country that demonstrates a partisan divide between beliefs in climate change is Australia. Despite it becoming increasingly evident that Australia will be adversely affected by climate change sooner and to a larger extent than most other countries, there has been a disproportionate response to this threat (Leviston & Walker, 2012). In 2007, the Labor government delivered a mandate on active leadership to combat climate change (Howarth & Foxall, 2010). In contrast the opposition party, the Liberal party, filled key positions with well-known climate change sceptics (Howarth & Foxall, 2010; Suri & Lofgren, 2010). This political divide between left-leaning and right-leaning parties, with right-leaning parties being climate change sceptics, has continued to grow (Hornsey, Harris, & Fielding, 2018; Tranter, 2011), partly driven by organised campaigns to deny its significance (Hamilton, 2007; McKewon, 2012). Furthermore, although attitudes towards climate change have been assessed in Australia, no study has addressed whether there is a difference in belief between climate change and global warming in Australia. This formed the motivation to further expand this research to Australia.

Lastly, separate from their direct replicability and generalizability across contexts, the phenomena itself may change over time. Leiserowitz et al. (2014) state that the connotative meanings of climate change and global warming are dynamic and change sometimes rapidly, and that with repeated use these terms may become synonymous or even swap positions in terms of their dominancy in public discourse. The original study was conducted in the USA during 2009, when Barack Obama, a vocal supporter for environmental policies (e.g., Obama, 2017; United Nations Framework Conventions on Climate Change, 2015), was just starting his presidency. Furthermore, the studies mentioned in section 1.3 were all conducted during President Obama's time in office. Since then there have been major political and social changes that might have created dynamic and rapid changes in the connotative meanings for climate change and global warming.

One such change can be detected simply through Google Trends (2020). Since Google started recording searches, in 2004, global warming has been the preferred term for the general public worldwide, including during the data collection of the original study and most of the ensuing work. However, a change occurred in March 2015, when climate change became a more popular term than global warming for the first time, and has consistently been so since July 2016. Of the studies in section 1.3, only Schuldt et al. (2017) collected data since this shift in term popularity. Thus, at least in popularity there has been a change in the use of terminology, with climate change supplanting global warming, as suggested by Leiserowitz et al. (2014).

Another change is within the political and social landscape since these studies were conducted. Firstly, within the USA a series of major political upheavals have occurred, culminating in the election of Donald Trump, who has expressed his disbelief in global warming (e.g., Trump, 2014b, 2018) and has implemented un-environmental policies (e.g., withdrawing from the Paris agreement; rolling back offshore drilling safety measures; committing to coal mining). Thus, it is important to understand whether these differences in the political and social climate in the USA have impacted the findings of Schuldt et al. (2011). Similarly, political upheaval has occurred in the UK, which voted to leave the European Union on June 23, 2016 (British Broadcasting Corporation, n.d.), and has had three prime ministers since then. Demonstrating that the UK has also gone through political and social turmoil, which has strengthened political division. Furthermore, since the original study Australia has introduced a carbon tax, repealed it, and been governed by five prime ministers, with the latest prime minister winning an election on a platform of increasing coal mining.

1.4. Present study

The primary aim of this study was to attempt a direct replication of the findings of Schuldt et al. (2011) in the USA. Although the original study did not suggest that their findings would generalize globally, another aim of this study was to examine the replicability of the findings in Australia and the UK. The following three hypotheses were put forward.

Hypothesis one. We predicted that an otherwise identical question would elicit lower levels of existence beliefs when worded in terms of global warming rather than climate change.

Hypothesis two. We predicted that this effect would be more pronounced for respondents who self-identify as Conservative as opposed to Liberal.

Hypothesis three. We predicted that the question wording effect and its interaction with political self-identification would be consistent across Australia, the UK, and the USA.

2. Method

This study, including the hypotheses, participant recruitment, variables, and analyses were pre-registered on the 26th December 2017 on the Open Science Framework (https://osf.io/6t4qu/?view_only=d1c8da935d844be1862301eeb1c85297). The main change to this preregistration was that recruitment continued for another four months after the original estimate of a year; this was primarily due to difficulty in recruiting Australian participants to the required sample size. Data collection was conducted between the 2nd of January 2018 and the 29th of April 2019, with ethics approval from the PPLS Research Ethics

Committee, University of Edinburgh on the 12th of December 2017.

2.1. Sample size

Sample size of the original study by Schuldt et al. (2011) was 2,267. Thus, in order to perform a high-powered analysis, a similar sample size of 2,300 was chosen for each country. This was achieved for the USA and UK, but not Australia. The failure to recruit sufficient participants within Australia meant that the study was underpowered in regards to detecting the smallest significant effect of 6.2 percentage points in the Australian Conservative sample, with a power of .68 and using a critical $\alpha = .05$, with a one-tailed Hypothesis that climate change would be rated as more believable than global warming.

2.2. Participants

Recruitment was done primarily through Prolific (an online research platform) and participants received £0.13 for their participation in this study. Various online research websites and social media were also used[1]; participants recruited through these resources received no compensation.

Participants ($N = 5,717$) were collected from three countries, USA ($N = 2,300$), UK ($N = 2,300$), and Australia ($N = 1,117$). Most participants ($N = 4,854$, 84.9%) were recruited through Prolific. Due to the nature of Prolific, we pre-screened based on political self-identification, to ensure as much as possible an even split between left- and right-leaning participants (this could only be done for the UK and USA, as this was not an option available for Australia). For American participants the pre-screener question asked "*Where would you place yourself along the political spectrum?*" with the responses of Conservative, Moderate, Liberal, Other, and N/A, which we screened on either the Conservative or Liberal options. For British participants the pre-screener question asked "*Please indicate where you believe your political ideology lies on this spectrum.*" with the responses of left, centre, right, N/A, which we screened on either left or right options. This pre-screening worked for the most part, although 190 UK participants pre-screened as right identified as Labour and 21 did the opposite. Similarly in the USA 93 participants were pre-screened as Conservative but indicated they were Democrats and 36 did the opposite. Participants whose pre-screener response did not match with their response in our survey were contacted to clarify, of this 112 people from the UK who were misclassified as right-leaning clarified, and 17 who were misclassified as left-leaning clarified. For the USA 43 who were misclassified as Conservative clarified, and 10 who were misclassified as Liberal clarified. Those participants who clarified their political preferences were included in the data, while those who did not respond were removed. Most participants clarified that their preferences had changed since the pre-screener and that they wished to have their most recent political preference recorded (i.e. the one answered in the survey), while a minority explained that they generally identified with the party they had selected in the survey, but had occasionally supported candidates of other parties or held views that tend to disagree with their identified party (e.g., identified as Democrat but voted for Trump or identified as Republican but held left-leaning views on social issues). However, it is important to note that these misclassifications are not necessarily problematic as they allow collection of participants who are closer to the centre but might lean towards one party or the other depending on candidates or issues. Distribution of demographic variables by question wording and country are reported in Table 1.

[1] The following research websites were used: Social Psychology Network, Psychology Research On the Net, Call for Participants, Surveycircle, PollPool, and SurveyTandem. The following social media websites were used: Twitter, Facebook; personal and research groups, and Reddit; r/SampleSize, r/AustralianPolitics, r/AskAnAustralian, r/research.

2.3. Measures

The measures were identical to those in the original study to ensure this was a direct replication. There were some minor changes (for interpretation reasons). Firstly, the question regarding education was changed from college to college/university. Secondly, for Australian and British participants the question regarding the American public was changed to Australian and British, respectively. Thirdly, for Australian and British participants Democrat and Republican were replaced with the appropriately named major left and right party. Lastly, Native Hawaiian was added as an ethnicity option.

2.3.1. Demographic variables

As per the original study age, sex, education level, and ethnicity were collected. As per the original study participants could choose between Male or Female as their sex, and age was left open ended. Participants were asked to choose one or more ethnicities that they considered themselves as and had the following options: *White*, *Asian*, *Black or African American*, *Native Hawaiian or Pacific Islander*, *American Indian or Alaskan Native*, or *Other* with a fill in option. Individuals who selected multiple categories were grouped as Other, and as per the original study Pacific Islander and Asian were grouped together. Lastly, participants were asked what the last grade of school they completed was and were provided with the options: *8*th *grade or less*, *Some high school*, *Graduated high school*, *Some college/university*, *Graduated college/university*, *Post-graduate*.

2.3.2. Recruitment time

Recruitment to this experiment was conducted over a year and four months. To ensure that this extended time period did not influence results, a *post-hoc* variable of recruitment time was created. This variable recorded how many months had passed since data collection began in January 2018 (coded as 0), with a month added at the beginning of each new month (e.g., 1st February 2018 = 1).

2.3.3. Environmental concern

As per the original study participants were asked: During the next year, how much they wanted the American/Australian/British public to do to help the natural environment? With the relevant country presented depending on what country participants indicated they lived in. Participants indicated their response on a scale of 1 (*A great deal*) to 5 (*Nothing*).

2.3.4. Political self-identification

Participants were also asked which party they identified with. The original study was conducted in the USA and provided the two main parties (Republican and Democrat) as well as Independent and Other/None of the above. Slight changes were made for the Australian and British versions of the survey. For the UK, Republican was replaced with Conservative/Tory, and Democrat was replaced with Labour; for Australia, Republican was replaced with Liberal, and Democrat was replaced with Labor. This matches on to the main right- and left-leaning parties of these countries. For analytic and reporting purposes Republican/Tory/Liberal will be referred to as Conservatives, Democrat/Labour/Labor will be referred to as Liberals, and Other/None of the above will be referred to as Other.

2.3.5. Question wording

The wording vignettes were identical to those found in Schuldt et al. (2011), see Appendix. Participants read one of these vignettes, framed either as *climate change* or *global warming*, and rated on a 7-point Likert scale from 1 (*Definitely HAS NOT BEEN happening*) to 7 (*Definitely HAS BEEN happening*), their personal opinion regarding whether or not the phenomenon described in the vignettes had been happening.

Table 1
Distribution of demographic variables by question wording.

Variable	Schuldt et al. (2011)			Total			Australia	
	O (2,261)	GW (1,162)	CC (1,099)	O (5,717)	GW (2,857)	CC (2,860)	O (1,117)	GW (560)
Political Self-Identification								
Conservative	32.4% (732)	31.2% (362)	33.7% (370)	34.4% (1,964)	35.1% (1,004)	33.6% (960)	17.0% (190)	17.1% (96)
Liberal	35.5% (803)	36.2% (421)	34.8% (382)	38.9% (2,223)	38.6% (1,103)	39.2% (1,120)	39.8% (445)	39.1% (219)
Independent	22.7% (514)	23.4% (272)	22.0% (242)	13.1% (748)	13.2% (376)	13.0% (372)	18.0% (201)	17.9% (100)
Other	9.4% (212)	9.2% (107)	9.6% (105)	13.7% (782)	13.1% (374)	14.3% (408)	25.2% (281)	25.9% (145)
Sex								
Female	58.8% (NR)	58.4% (NR)	59.1% (NR)	51.0% (2,915)	51.6% (1,474)	50.4% (1,441)	41.8% (467)	41.1% (230)
Ethnicity								
White	90.0% (NR)	90.6% (NR)	89.4% (NR)	85.3% (4,877)	85.4% (2,440)	85.2% (2,437)	75.5% (843)	75.5% (423)
Black/African American	5.8% (NR)	5.4% (NR)	6.2% (NR)	2.8% (159)	2.7% (78)	2.8% (81)	0.6% (7)	0.2% (1)
American Indian/Alaskan Native	0.7% (NR)	0.8% (NR)	0.5% (NR)	0.1% (8)	0.2% (7)	0.0% (1)	0.0% (0)	0.0% (0)
Asian/Pacific Islander/Native Hawaiian*	1.6% (NR)	1.7% (NR)	1.5% (NR)	6.2% (352)	5.7% (163)	6.6% (189)	15.0% (168)	14.6% (82)
Other	1.9% (NR)	1.4% (NR)	2.4% (NR)	5.6% (321)	5.9% (169)	5.3% (152)	8.9% (99)	9.6% (54)
Educational Attainment								
8th Grade or Less	0.4% (NR)	0.6% (NR)	0.2% (NR)	0.3% (20)	0.1% (4)	0.6% (16)	0.2% (2)	0.0% (0)
Some High School	2.5% (NR)	2.8% (NR)	2.2% (NR)	2.3% (130)	2.5% (72)	2.0% (58)	3.3% (37)	4.1% (23)
Graduated High School	16.1% (NR)	15.6% (NR)	16.6% (NR)	13.5% (771)	13.3% (380)	13.7% (391)	15.3% (171)	16.4% (92)
Some College/University	30.3% (NR)	30.5% (NR)	30.1% (NR)	28.0% (1,602)	27.7% (791)	28.4% (811)	27.3% (305)	27.1% (152)
Graduated College/University	30.2% (NR)	29.5% (NR)	30.8% (NR)	38.4% (2,194)	38.3% (1,094)	38.5% (1,100)	35.7% (399)	34.3% (192)
Post-Graduate	20.5% (NR)	20.9% (NR)	20.1% (NR)	17.5% (1,000)	18.1% (516)	16.9% (484)	18.2% (203)	18.0% (101)
Age (Years)								
Mean (Standard Deviation)	50.15 (NR)	49.95 (NR)	50.36 (NR)	33.83 (12.46)	33.77↓ (12.43)	33.89 (12.49)	29.53↓ (10.27)	29.41↓ (10.49)

Variable	Australia	UK			USA		
	CC (557)	O (2,300)	GW (1,139)	CC (1,161)	O (2,300)	GW (1,158)	CC (1,142)
Political Self-Identification							
Conservative	16.9% (94)	38.8% (892)	40.6% (463)	37.0% (429)	38.3% (882)	38.4% (445)	38.3% (437)
Liberal	40.6% (226)	39.0% (898)	38.4% (437)	39.7% (461)	38.3% (880)	38.6% (447)	37.9% (433)
Independent	18.1% (101)	5.7% (131)	5.6% (64)	5.8% (67)	18.1% (416)	18.3% (212)	17.9% (204)
Other	24.4% (136)	16.5% (379)	15.4% (175)	17.6% (204)	5.3% (122)	4.7% (54)	6.0% (68)
Sex							
Female	42.5% (237)	59.9% (1,377)	60.9% (694)	58.8% (683)	46.6% (1,071)	47.5% (550)	45.6% (521)
Ethnicity							
White	75.4% (420)	93.6% (2,153)	93.6% (1,066)	93.6% (1,087)	81.8% (1,881)	82.1% (951)	81.4% (930)
Black/African American	1.1% (6)	1.2% (28)	1.3% (15)	1.1% (13)	5.4% (124)	5.4% (62)	5.4% (62)
American Indian/Alaskan Native	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)	0.3% (8)	0.6% (7)	0.1% (1)
Asian/Pacific Islander/Native Hawaiian*	15.4% (86)	2.5% (58)	2.0% (23)	3.0% (35)	5.5% (126)	5.0% (58)	6.0% (68)
Other	8.1% (45)	2.7% (61)	3.1% (35)	2.2% (26)	7.0% (161)	6.9% (80)	7.1% (81)
Educational Attainment							
8th Grade or Less	0.4% (2)	0.6% (14)	0.3% (3)	0.9% (11)	0.2% (4)	0.1% (1)	0.3% (3)
Some High School	2.5% (14)	2.5% (57)	2.5% (28)	2.5% (29)	1.6% (36)	1.8% (21)	1.3% (15)
Graduated High School	14.2% (79)	14.7% (337)	15.2% (173)	14.1% (164)	11.4% (263)	9.9% (115)	13.0% (148)
Some College/University	27.5% (153)	23.3% (535)	22.4% (255)	24.1% (280)	33.1% (762)	33.2% (384)	33.1% (378)
Graduated College/University	37.2% (207)	40.8% (939)	41.1% (468)	40.6% (471)	37.2% (856)	37.5% (434)	37.0% (422)
Post-Graduate	18.3% (102)	18.2% (418)	18.6% (212)	17.7% (206)	16.5% (379)	17.5% (203)	15.4% (176)
Age (Years)							
Mean (Standard Deviation)	29.65 (10.06)	36.60 (13.12)	36.42 (13.23)	36.78 (13.02)	33.14 (12.06)	33.26 (11.82)	33.02 (12.29)

Notes: O = Overall; GW = global warming; CC = climate change; NR = not reported; Schuldt et al., 2011 did not report exact numbers for sex, education, or age; * = Schuldt et al. did not have Native Hawaiian as a category, ↓ N-1, as one person did not provide age data.

2.4. Procedure

After giving consent, participants indicated which country they permanently resided in. This split the survey, so questions were framed to the appropriate country. Participants first completed in one section the political party they identified with, demographic variables (age, gender, ethnicity, and education), and the single-item environmental concern measure. In the next section participants were randomly assigned (balanced assignment through Qualtrics) to either the climate change or global warming condition.

3. Results

As per the original paper, the continuous variable of belief score was transformed into a binary categorical variable. Respondents who endorsed a belief score of 5 or above were coded as believers, and those scoring below 5 as disbelievers. This new variable was used for the following three hypotheses.

3.1. Hypothesis one

A simple chi-square test, with Yates' continuity correction, was performed to assess the difference in endorsements for climate change and global warming. Overall 88.8% of participants indicated that they believed the phenomenon was real when the question referred to climate change, and 88.0% when the question referred to global warming. This resulted in a non-significant wording effect χ^2 (1, N = 5,717) = 0.93, p = .335, V = .01.

3.2. Hypothesis two

A chi-square test, with Yates' continuity correction, was performed to see if there was a difference in endorsements for climate change and global warming between political self-identification categories. A breakdown by political self-identification reveals that the non-significant wording effect was found within each political self-identification. For Conservative respondents 79.7% of participants expressed belief in climate change and 77.0% in global warming, resulting in a non-significant wording effect for Conservatives χ^2 (1, N = 1,964) = 1.94, p = .163, V = .03. For Liberal respondents 96.6% of participants expressed belief in climate change and 97.2% in global warming, resulting in a non-significant wording effect for Liberals χ^2 (1, N = 2,223) = 0.45, p = .503, V = .01. Finally Independent and Other respondents showed non-significant wording effects: 87.6% of Independents believed in climate change and 87.2% in global warming (χ^2 (1, N = 748) < 0.01, p = .956, V < .01), and 90.0% of Others expressed belief in climate change and 90.9% in global warming (χ^2 (1, N = 782) = 0.11, p = .739, V = .01).

The continuous scale was used to perform a 2 (Condition: global warming versus climate change) x 4 (Political self-identification: Conservative, Liberal, Independent, or Other) between-subjects ANOVA to test for differences in mean belief level. Due to the unbalanced design, Type II sums of squares were used. The assumptions of normality and homogeneity of residuals were violated. However, results did not vary from those suggested by the analysis based on beliefs treated as a binary variable. Counter to Hypothesis two, no significant interaction was found F (3, 5,709) = 1.10, p = .348, ηp^2 < .01. Thus, the interaction model was reduced to a main-effects model. There was no main-effect of question wording (F (1, 5,712) = 0.08, p = .772, ηp^2 < .01). However, there was a main-effect of political self-identification (F (3, 5,712) = 269.83, p < .001, ηp^2 = .12). These effects remained when controlling for the demographic variables of age, gender, ethnicity, and education, as well as the variable of months since initial recruitment. See Table 2 for a summary of group means.

3.3. Hypothesis three

A chi-square test, with Yates' continuity correction, was performed to see if there was a difference in endorsement for climate change and global warming as a function of country (Australia, UK, and USA), revealing no differences in beliefs within countries between question wording conditions. For Australia, 95.3% of participants indicated that they believed in climate change, and 95.7% in global warming. This resulted in a non-significant wording effect in Australia χ^2 (1, N = 1,117) = 0.03, p = .870, V < .01. For the UK, 90.4% of participants believed in climate change, and 89.1% in global warming. This resulted in a non-significant wording effect in the UK χ^2 (1, N = 2,300) = 0.96, p = .327, V = .02. For the USA, 84.0% of participants believed in climate change, and 83.1% in global warming. This resulted in a non-significant wording effect in the USA χ^2 (1, N = 2,300) = 0.28, p = .599, V = .01.

A chi-square test, with Yates' continuity correction, was then performed to see if there was a difference in endorsements for climate change and global warming within countries (Australia, UK, and USA), by political self-identification. In Australia, 90.4% of Conservative respondents believed in climate change and 89.6% in global warming, resulting in a non-significant wording effect for Conservatives χ^2 (1, N = 190) < 0.01, p = 1.000, V < .01. For Liberal respondents, 97.3% of participants expressed belief in climate change and 98.2% in global warming, resulting in a non-significant wording effect for Liberals χ^2 (1, N = 445) = 0.07, p = .788, V = .01. Finally Independent and Other respondents showed non-significant wording effects: 95.0% of Independents believed in climate change and 95.0% in global warming (χ^2 (1, N = 201) < 0.01, p = 1.000, V < .01), and 95.6% of Others believed in climate change and 96.6% in global warming (χ^2 (1, N = 281) = 0.01, p = .914, V = .01).

In the UK, 87.6% of Conservative respondents believed in climate change and 84.7% in global warming, resulting in a non-significant wording effect for Conservatives χ^2 (1, N = 892) = 1.41, p = .235, V = .04. For Liberal respondents, 95.2% believed in climate change and 95.4% in global warming, resulting in a non-significant wording effect for Liberals χ^2 (1, N = 898) < 0.01, p = 1.000, V < .01. Finally, Independent and Other respondents showed non-significant wording effects: 89.6% of Independents believed in climate change and 87.5% in global warming (χ^2 (1, N = 131) = 0.01, p = .925, V = .01), and 85.8% of Others believed in climate change and 85.7% in global warming (χ^2 (1, N = 379) = 0.00, p = 1.000, V = .00).

In the USA, 69.6% of Conservative respondents believed in climate change and 66.3% in global warming, resulting in a non-significant wording effect for Conservatives χ^2 (1, N = 882) = 0.94, p = .333, V = .03. For Liberal respondents, 97.7% believed in climate change and 98.4% in global warming, resulting in a non-significant wording effect for Liberals χ^2 (1, N = 880) = 0.31, p = .578, V = .02. Finally, Independent and Other respondents showed non-significant wording effects: 83.3% of Independents believed in climate change and 83.5% in global warming (χ^2 (1, N = 416) < 0.01, p = 1.00, V < .01), and 91.2% of Others believed in climate change and 92.6% in global warming (χ^2 (1, N = 122) < 0.01, p = 1.00, V < .01).

Lastly, the continuous belief scale was used to perform a 3 (Country: Australia, UK, USA) x 2 (Condition: global warming versus climate change) x 4 (Political self-identification: Conservative, Liberal, Independent, and Other) between-subjects ANOVA. Due to the unbalanced design, Type II sums of squares were used. The assumptions of

[2] There was now a significant difference between American Liberals and American Others in environmental belief. Australian Liberals now believed the public should help more than British Liberals. Australian Others now believed the public should help more than American Others, and Australian Independents. American Liberals now believed the public should help more than American Others. Lastly, there was now no longer a difference in the association between belief and public help score within Britain.

Table 2
Overall belief scores in environmental phenomena.

Political Self-Identification	Global warming		Climate change		Overall	
	M [95% CI]	SD	*M* [95% CI]	SD	*M* [95% CI]	SD
Conservative	5.45 [5.35, 5.56]	1.69	5.55 [5.44, 5.65]	1.62	5.50 [5.43, 5.57]	1.66
Liberal	6.67 [6.62, 6.71]	0.81	6.62 [6.57, 6.68]	0.92	6.64 [6.61, 6.68]	0.87
Independent	6.13 [5.98, 6.27]	1.46	6.14 [6.00, 6.29]	1.40	6.13 [6.03, 6.24]	1.43
Other	6.37 [6.24, 6.50]	1.28	6.32 [6.19, 6.44]	1.29	6.34 [6.25, 6.43]	1.28
Overall	6.13 [6.08, 6.18]	1.43	6.16 [6.10, 6.21]	1.38		

Post-hoc contrasts, with Bonferroni adjustments, critical $\alpha = .008$, revealed several significant differences for political self-identification. Liberals were more likely to endorse a higher belief in environmental phenomena than Conservatives ($p < .001$, $d = 0.86$), Independents ($p < .001$, $d = 0.43$), and Others ($p < .001$, $d = 0.27$). Conservatives believed in environmental phenomena less than Independents ($p < .001$, $d = 0.41$) and Others ($p < .001$, $d = 0.57$). Lastly, it was found that Others believed in environmental phenomena more than Independents ($p = .002$, $d = 0.15$).

normality and homogeneity of residuals were violated. However, results did not vary from those suggested by the chi-square analysis, and ANOVA is a robust measure to violations of assumptions, which is to be expected for large samples. It was found that the three-way interaction was not significant F (6, 5,693) = 0.41, $p = .872$, $\eta p^2 < .01$. Thus, the two-way interactions were tested of which only the political self-identification and country interaction was significant F (6, 5,699) = 41.47, $p < .001$, $\eta p^2 = .04$. The non-significant interactions of question wording and country (F (2, 5,699) = 0.13, $p = .879$, $\eta p^2 < .01$) and question wording and political self-identification (F (3, 5,699) = 1.06, $p = .367$, $\eta p^2 < .01$) were dropped. The final model included the main effects of political self-identification, question wording, country, and the interaction between political self-identification and country. Reiterating previous findings there was no main-effect of question wording (F (1, 5,704) = 0.29, $p = .593$, $\eta p^2 < .01$), but there was a significant main-effect for political self-identification (F (3, 5,704) = 258.19, $p < .001$, $\eta p^2 = .12$) and a significant main-effect of country (F (2, 5,704) = 54.819, $p < .001$, $\eta p^2 = .02$). These effects remained significant when controlling for the demographic variables of age, gender, ethnicity, and education, as well as the number of months since initial recruitment. See Table 3 for a summary of group means.

Post-hoc contrasts with Bonferroni adjustments, critical $\alpha = .017$, revealed significant differences between countries. It was found that Australians ($M = 6.56$, 95%CI [6.51, 6.62], $SD = 0.94$) were more likely to endorse beliefs in climate change/global warming than British participants ($M = 6.17$, 95%CI [6.12, 6.22], $SD = 1.29$, $p < .001$, $d = 0.35$), or Americans ($M = 5.91$, 95%CI [5.85, 5.98], $SD = 1.64$, $p < .001$, $d = 0.48$). British participants were more likely to endorse beliefs in climate change/global warming than Americans ($p < .001$, $d = 0.17$). The significant interaction between political self-identification and country (F (6, 5,704) = 41.49, $p < .001$, $\eta p^2 = .04$) is shown in Fig. 1 and, appears to be primarily driven by American Conservatives being the least likely of all groups to endorse beliefs in climate change/global warming.

Additional *post-hoc* comparisons were performed to find where these differences lay exactly, see Appendix A in the supplementary material. In summary there were differences between countries, within each political self-identification category, with no consistent differences. Furthermore, there were differences between political self-identification categories within countries. It was consistently found that Conservatives believed less in climate change/global warming than Liberals in all three countries. There were no consistent patterns in regards to Other or Independent political self-identifications.

3.4. Exploratory analysis

An exploratory analysis was also conducted as to how much participants believed that the public should help the natural environment. This scale was scored so that higher scores reflected higher levels of environmental support. These exploratory analyses were not pre-registered. A 3 (Country: Australia, UK, USA) x 4 (Political self-identification: Conservative, Liberal, Independent, and Other) between-subjects ANOVA was conducted. Due to the unbalanced design, Type II sums of squares were used. The assumptions of normality and homogeneity of residuals were violated, although ANOVA is robust to violations of assumptions in large samples. A main effect of country was found F (2, 5,705) = 24.26, $p < .001$, $\eta p^2 = .01$, as well as a main effect of political self-identification F (3, 5,705) = 182.22, $p < .001$, $\eta p^2 = .09$. More importantly, a significant interaction was found between country and political self-identification on belief in how much the public should help the natural environment F (6, 5,705) = 16.75, $p < .001$. $\eta p^2 = .02$. The interaction is shown in Fig. 2, suggesting that belief in how much the public should help the environment varied based on political self-identification and country of origin. These effects remained significant when controlling for the demographic variables of age, gender, ethnicity, and education, as well as the number of months since initial recruitment. See Table 4 for a summary of group means.

Additional *post-hoc* comparisons were performed to find the sources of these differences (Appendix B in the supplementary material). To briefly summarise, differences between countries varied depending on which political self-identification category was examined. For example, when looking at Conservatives there was no difference between Australians and the British, but American Conservatives were significantly less likely to believe that the public should help compared to Australians and the British. In contrast, when examining Liberals, there was no difference between Australians and Americans, or Australians and the British, but British Liberals were less likely to believe the public should help compared to Americans. In summary, there were several differences between countries within all political self-identification categories, but no consistent patterns emerged. Furthermore, there were consistent differences between political self-identification categories within all countries: Conservatives tended to feel that the public should help the environment less than Liberals across countries. There were no consistent patterns in regards to Other or Independent political self-identifications.

4. Discussion

4.1. Replication

Unlike in Schuldt et al. (2011), the effect of question wording was not found. This lack of a difference in belief between climate change and global warming was consistent not only within the USA across the four political self-identification categories but also in the UK and Australia. There are several possible reasons for these differences in findings.

Firstly, there were some sampling differences between the original study and the current replication, aside from cross-country comparisons. Our American sample was relatively similar to the original sample in regards to political self-identification, but there were some

Table 3
Country belief scores in environmental phenomena.

Political Self-Identification	Australia						UK					
	Global warming		Climate change		Overall		Global warming		Climate change		Overall	
	M [95% CI]	*SD*	*M* [95% CI]	*SD*	*M* [95% CI]	*SD*	*M* [95% CI]	*SD*	*M* [95% CI]	*SD*	*M* [95% CI]	*SD*
Conservative	6.09 [5.84, 6.35]	1.27	6.29 [6.04, 6.53]	1.21	6.19 [6.01, 6.37]	1.24	5.84 [5.71, 5.96]	1.40	5.91 [5.79, 6.03]	1.29	5.87 [5.78, 5.96]	1.35
Liberal	6.73 [6.64, 6.81]	0.63	6.65 [6.54, 6.76]	0.83	6.69 [6.62, 6.76]	0.74	6.50 [6.41, 6.59]	0.98	6.49 [6.39, 6.58]	1.03	6.49 [6.43, 6.56]	1.01
Independent	6.55 [6.34, 6.76]	1.05	6.42 [6.21, 6.62]	1.07	6.48 [6.34, 6.63]	1.06	6.05 [5.67, 6.42]	1.53	6.33 [6.02, 6.63]	1.27	6.19 [5.95, 6.43]	1.40
Other	6.69 [6.56, 6.82]	0.78	6.64 [6.50, 6.78]	0.85	6.67 [6.57, 6.76]	0.81	6.11 [5.88, 6.33]	1.52	6.09 [5.89, 6.29]	1.48	6.10 [5.95, 6.25]	1.49
Overall	6.58 [6.50, 6.65]	0.91	6.54 [6.46, 6.62]	0.96			6.14 [6.07, 6.22]	1.32	6.19 [6.12, 6.27]	1.26		

Political Self-Identification	USA					
	Global warming		Climate change		Overall	
	M [95% CI]	*SD*	*M* [95% CI]	*SD*	*M* [95% CI]	*SD*
Conservative	4.92 [4.74, 5.09]	1.89	5.03 [4.86, 5.20]	1.82	4.98 [4.85, 5.10]	1.86
Liberal	6.80 [6.74, 6.86]	0.66	6.75 [6.68, 6.83]	0.81	6.78 [6.73, 6.83]	0.74
Independent	5.95 [5.74, 6.16]	1.57	5.95 [5.73, 6.16]	1.56	5.95 [5.80, 6.10]	1.56
Other	6.37 [6.01, 6.73]	1.34	6.37 [6.06, 6.67]	1.28	6.37 [6.14, 6.60]	1.30
Overall	5.90 [5.80, 6.00]	1.66	5.93 [5.83, 6.02]	1.62		

differences. Specifically, our sample contained a slightly greater number of Democrats and Republicans (average increase of 2.8 and 5.9 percentage points respectively) and thereby fewer Independents and Others (average decrease of 4.6 and 4.1 percentage points respectively). Also, it had comparatively fewer females (average decrease of 12.2 percentage points) and White participants (average decrease of 8.2 percentage points) and slightly more Asian/Pacific Islander/Native Hawaiian and Other participants (average increase of 3.9 and 5.1 percentage points respectively), with very small differences for Black/African American participants (0.4 percentage point difference) and American Indian/Alaskan Native participants (0.3 percentage point difference). Our American participants were on average 17 years younger, but were more likely to have some college/university education or to have graduated from college/university (average increase of 2.8 and 7.1 percentage points respectively); fewer people had completed 8th grade or less or some high school (average decrease of 0.2 and 0.9 percentage points respectively), or had only graduated from high school or had post-graduates degrees (average decrease of 4.7 and 4.0 percentage points respectively). These sampling differences might account for why this study came to different conclusions than the original. However, it is important to note that none of these demographic variables altered the main or interaction effects of interest. Although other research has found racial differences in climate-related opinions (e.g., Leiserowitz, Cutler, & Rosenthal, 2017), we found only a few differences in *post-hoc* and exploratory analyses when examining the most common ethnicity in our dataset (White).[2]

Another difference between samples was the recruitment methods used. The original study collected their participants through the RAND Corporation, which was embedded in the American Life Panel and was collected over a two month period. However, the data from this replication study was conducted primarily through Prolific and was collected over a 15 month period. One key difference between recruitment methods was screening. The original study comes from a nationally representative, probability-based panel, and no screening of participants was conducted. This replication study though did provide initial screening to ensure an equal split of right- and left-leaning participants. Thus, our sample might have screened out moderates that were included in the original study. However, if this was the case one would expect a stronger effect of question wording, as suggested by Morin-Chassé and Lachapelle (2019). Another difference is the time taken to collect data. The data for this replication study was collected over a longer period of time. However, although time was a significant covariate, it had no effect on the main effects or interactions that the original and this replication were interested in.

Lastly, a major difference between the original study and the current replication is when the data was collected. Original study data were collected in 2009, at the beginning of Obama's turn in office, and when global warming was a more popular search term than climate change according to Google Trends. Since then there have been major social, political, and indeed environmental changes. Thus, it might be that these changes over the past decade account for the difference in findings. As Leiserowitz et al. (2014) argue, the connotative meanings of climate change and global warming are dynamic and change sometimes rapidly, and that with repeated use these terms may become synonymous or even swap positions in terms of their dominancy in public discourse.

Thus, the connotation of climate change as being a natural phenomenon rather than a human induced one (Whitmarsh, 2009) might not exist anymore. Although the difference in question wording was found as late as 2016 (Schuldt et al., 2017), shifts in cultural awareness and uses of the two terms might be why this question wording effect was not found. This suggests two things. Firstly, even the findings of this replication might be temporally bound and changes in the connotative meaning of these two terms, or indeed other terms, may further change over time. Secondly, as a result of this, research and policy focussing on minor wording changes, must be frequently updated to

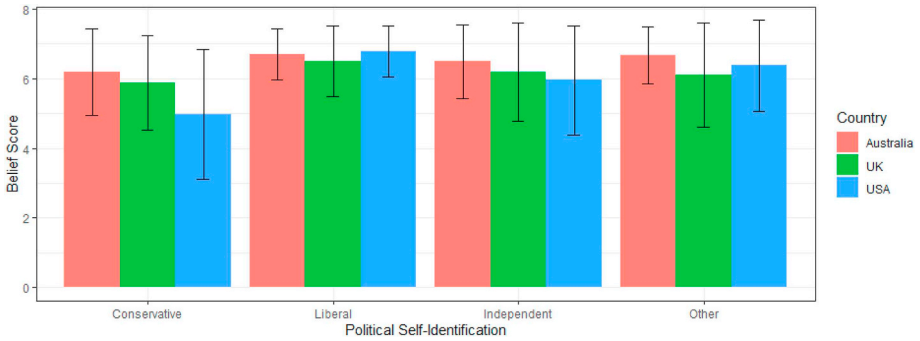

Fig. 1. The interaction between political self-identification and country on belief in environmental phenomena.

ensure that findings are still temporally relevant.

Thus, future research should continue to examine differences in question framing, although some changes should be made. Firstly, this study, as the original, used a single measure of belief. Although the belief question was on a Likert scale, allowing variation in responses, single item measurements of belief may be limiting in that they do not cover the possibly more nuanced belief concepts around climate change and global warming with sufficient breadth. Instead future studies could employ lengthier measures of climate belief, either through longer pro-environmental attitudes measures (e.g., New Environmental Paradigm; Dunlap, Van Liere, Mertig, & Jones, 2000) or longer belief measures examining different aspects of belief (e.g., reality, cause, consequences; van Valkengoed, Steg, & Perlaviciute, 2019). It might be that longer more nuanced measures are more revealing of partisan differences in beliefs.

Another avenue for future research is to employ more nuanced measures of political ideology. This study, like the original, simply asked participants to make a discrete choice as to political self-identification rather than examine the full spectrum of political beliefs. There might indeed be differences in belief within these discrete choices and this was not explored here. For example, there might be differences between moderate Republicans and conservative Republicans as found by Morin-Chassé and Lachapelle (2019).

4.2. Political self-identification and country differences

Despite not finding an interaction effect between political self-identification and question wording, the main effect of political self-identification was replicated. A consistent effect across Australia, the UK, and the USA was found, in that Conservatives were less likely to believe in environmental phenomena than Liberals. The magnitude of this difference did however vary between countries. For Conservatives there was no significant difference between Australians and the British in belief in environmental phenomena, but Americans did have a significantly lower level of belief in environmental phenomena. Interestingly, it was British Liberals who believed less in environmental phenomena than their American and Australian counterparts, who did not differ in their beliefs in environmental phenomena. It appears that the difference in beliefs, in environmental phenomena, between Conservatives and Liberals is most pronounced in the USA with a mean difference around double that of the difference found between Conservatives and Liberals in the UK and Australia. This greater political polarisation in the USA is consistent with previous research in this area (Pew, 2015). This demonstrates that despite the growing urgency and consequences of climate change and global warming the issue is still politically polarised.

It may be that the rate of disbelief has changed considerably since the original study, although it is important to note that our samples were collected on different platforms with different sampling methodology. However, when compared to other studies carried out around the same time as the original study and using varied methodologies and samples (Leviston & Walker, 2011, pp. 1–22; Poortinga et al., 2011; Schuldt et al., 2011), we found similar levels of increase in belief rates towards climate change/global warming, suggesting that methodological and sample differences may not be an all-determining factor of the change in belief rates. To the extent that our findings are comparable to these earlier studies, it appears that belief scores in all three countries, have increase by 10–20 percentage points since these earlier studies. This is encouraging because the need for greater action is widely acknowledged, as the threat of environmental collapse draws nearer. Although we addressed beliefs rather than actions, it is argued that beliefs in environmental issues are required for serious action on environmental issues (Krosnick et al., 2006), which has been demonstrated in other environmental areas (e.g., ocean acidification; Mossler, Bostrom, Kelly, Crosman, & Moy, 2017). An exploratory analysis further demonstrated a similar finding in regards to individuals' beliefs that their respective country's public should do more. An exploratory analysis of the correlation between belief in environmental phenomena and that the public should help more was overall high $r = .44$, and varied between $r = .23$ and .44 depending on the country and political self-identification combination. This correlational evidence combined with the theoretical evidence points to the importance of belief in

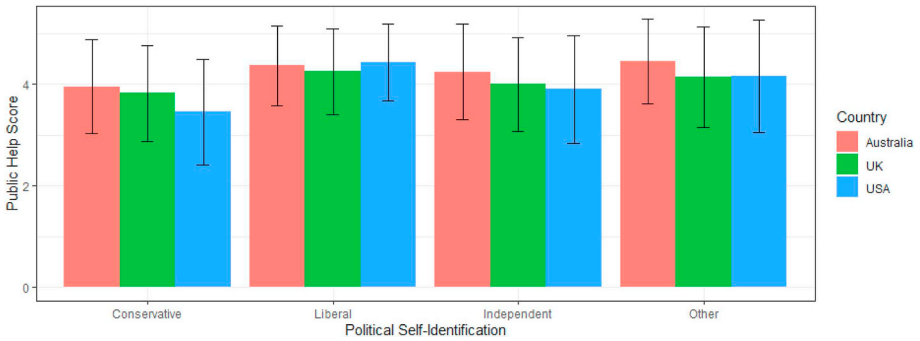

Fig. 2. The interaction between political self-identification and country on belief that the public should help the natural environment.

Table 4
Public help score by country.

	Australia		UK		USA	
	M [95% CI]	SD	*M* [95% CI]	SD	*M* [95% CI]	SD
Conservative	3.95 [3.82, 4.08]	0.92	3.83 [3.77, 3.89]	0.94	3.46 [3.39, 3.53]	1.03
Liberal	4.37 [4.30, 4.45]	0.79	4.26 [4.20, 4.31]	0.85	4.43 [4.38, 4.48]	0.76
Independent	4.25 [4.12, 4.38]	0.94	4.00 [3.84, 4.16]	0.92	3.90 [3.80, 4.01]	1.06
Other	4.46 [4.36, 4.55]	0.83	4.14 [4.04, 4.24]	0.99	4.16 [3.97, 4.36]	1.11
Overall	4.30 [4.25, 4.35]	0.87	4.06 [4.02, 4.09]	0.93	3.95 [3.91, 3.99]	1.04

support for environmental policy. Interestingly the exploratory correlation analysis revealed that the link between belief and action was significantly stronger in Conservative, compared to Liberal, individuals for British ($z = 2.13$, $p = .030$) and American samples ($z = 2.55$, $p = .010$). This further points to the importance in targeting Conservatives' beliefs in environmental phenomena, in order to improve climate change action.

4.3. Political polarisation

As evidenced in this study and in past research there is indeed a politicisation of belief in climate change and global warming, with Liberals cross-nationally believing more in these phenomena than their Conservative counterparts. This is problematic as despite political differences in belief, there is strong scientific evidence that climate change is real (e.g., Intergovernmental Panel on Climate Change, 2018; Klein et al., 2017; United Nations Environment Programme, 2019), and although there will be disparities in who will be impacted first and to what degree, this will not be decided by one's political ideology. Thus, unanimous international bipartisanship is required to create the universal response needed to tackle this ecological dilemma. Although the initial study by Schuldt et al. (2011) hinted at a possibility for an easy tool for interventions attempting to reduce this political partisanship, this was not replicated here. This suggests other routes are required to increase Conservatives' belief in environmental phenomena, at the present time.

One potential route is through framing the solutions of climate change in an economic manner. Recent work in the European Union examining willingness to donate money to offset carbon, split political ideology across two dimensions, economic and social (Azarova, Cohen, Kollmann, & Reichl, 2019). The typical results of right-leaning political ideology being negatively related to pro-environmental behaviour, and left-leaning political ideology being positively related to pro-environmental behaviour was only found along the social dimension. In contrast, when examining the economic dimension, being left-leaning had no association with donation but being right-leaning saw an increase in donation. Furthermore, the strength of this was similar to the negative association found between right-leaning and donation when looking at the social dimension. This suggests that a framing of the economic benefits could reverse the usual negative correlation seen between politically right ideology and pro-environmental behaviour.

5. Conclusion

In conclusion this present study adds additional insight into the effect of question wording and political self-identification on climate change/global warming beliefs. This study continued to demonstrate the consistent association between political self-identification and belief across all three countries. Although there appears to be some evidence of increasing public belief in climate change and global warming over time, there is still strong evidence of political partisanship towards believing and willingness to help the environment. Greater emphasis should be placed on how to reduce this political partisanship, by increasing Conservative beliefs in environmental phenomena. We found that question wording in regards to climate change as opposed to global warming might no longer account for this political partisanship, but other reasons should be explored. As for the lack of wording effect, the connotative meanings of words specifically and the environmental discourses more broadly are dynamic phenomena and may change rapidly. With repeated use terms such as climate change and global warming may become synonymous or even swap positions in terms of their dominancy in public discourse.

CRediT authorship contribution statement

Alistair Raymond Bryce Soutter: Conceptualization, Methodology, Formal analysis, Investigation, Data curation, Writing - original draft, Writing - review & editing, Funding acquisition. **René Mõttus:** Writing - original draft, Writing - review & editing, Supervision, Funding acquisition.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jenvp.2020.101413.

Appendix. Wording Vignettes

Climate Change

You may have heard about the idea that the world's temperature may have been changing over the past 100 years, a phenomenon sometimes called 'climate change'. What is your personal opinion regarding whether or not this has been happening?

Global Warming

You may have heard about the idea that the world's temperature may have been going up over the past 100 years, a phenomenon sometimes called 'global warming'. What is your personal opinion regarding whether or not this has been happening?

Responses as presented

Definitely HAS NOT BEEN happening
Probably HAS NOT BEEN happening
Unsure, but leaning toward it HAS NOT BEEN happening
Not sure either way
Unsure, but leaning toward it HAS BEEN happening
Probably HAS BEEN happening
Definitely HAS BEEN happening

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6.2 Chapter Conclusion

In this chapter we performed a pre-registered large cross-country replication of a study conducted by Schuldt and colleagues (2011). A sample of 5,717 participants was recruited from the USA (*N* = 2,300), UK (*N* = 2,300), and Australia (*N* = 1,117). We assessed whether the interactive effect between question wording and political preferences (i.e. political self-identification) on beliefs in the existence of climate change/global warming replicated. It was found that there was no difference in beliefs between climate change and global warming within the combined sample or within any of the country samples. Furthermore, the interactive effect between question wording and political preferences on beliefs in climate change/global warming did not replicate in the combined sample or in any of the country samples. These findings suggested that the interactive effect found by Schuldt and colleagues (2011, 2015, 2017) no longer existed in the temporal and cultural contexts examined within this chapter. The one result that was consistently replicated was that Conservatives believed less in climate change/global warming than Liberals.

In order for this to be a direct replication of a study conducted by Schuldt and colleagues (2011) we were limited in our ability to alter the methodology employed. Thus, we limited our examination of pro-environmental beliefs to a single-item measure. This measure simply asked participants their personal opinion regarding whether or not the phenomenon (global warming or climate change) presented to them was happening. Previous research had demonstrated that minor changes in this question could alter responses in beliefs towards environmental phenomena. For example, two studies found no interaction between political preferences and question wording (global warming versus climate change) when asked about the seriousness of the issue (Dunlap, 2014; Villar & Krosnick, 2011). Schuldt and colleagues (2017) argued that this difference (seriousness versus existence) might have resulted in the non-significant interactive effect found by Dunlap, and Villar and Krosnick.

Furthermore, even within their own research Schuldt and colleagues (2015) found that this interactive effect did not extend to other outcomes. Schuldt and colleagues (2015) found that this interactive effect was not present regarding participants' beliefs in the perceived scientific consensus on the environmental phenomenon presented to them, nor the participants' support for climate mitigation policy.

Another limitation of our study was that only a single operationalisation of political preferences was used, that being which political party participants self-identified with. Political preferences can be operationalised in several ways, which can result in important differences in how individuals report their political preferences. For example, self-identification and voting tendency are two separate operationalisations of political preferences. Research had demonstrated that factors other than self-identification impact voting tendency, such as knowledge of politics (Delli Carpini & Keeter, 1996), educational attainment (Brady, Verba, & Schlozman, 1995), and campaign techniques (Fisher, Fieldhouse, Johnston, Pattie, & Cutts, 2016). As alterations to the outcome examined (e.g. seriousness versus existence) were suggested to influence the interaction between question wording and political preferences (Schuldt et al., 2017), it might be that alterations to how political preferences are operationalised might too influence this interaction.

These limitations formed the motivation for the study reported in Chapter 7. In Chapter 7 we examined multiple outcomes (i.e. various pro-environmental attitudes and behaviours) as well as different operationalisations of political preferences. This was done to examine a) how political preferences were associated with several pro-environmental attitudes and behaviours; and b) whether altering the operationalisation of political preferences would alter the interaction between political preferences and question wording on beliefs in the existence of climate change/global warming.

Another motivation for the study reported in Chapter 7 was to examine the role of personality traits on these associations. In Chapter 4 we demonstrated that personality traits were robustly associated with pro-environmental attitudes and behaviours. Similarly, a meta-analysis demonstrated that personality traits were robustly associated with political preferences (Sibley et al., 2012). Despite the connection between personality traits, political preferences, and pro-environmental attitudes and behaviours, little research had examined these variables together (Brick & Lewis, 2016). Thus, we modelled these variables together, in order to understand whether the interaction between political preferences and question wording on beliefs in the existence of climate change/global warming remained when controlling for personality traits. Furthermore, we examined how political preferences were associated with pro-environmental attitudes and behaviours, when controlling for personality traits.

Lastly, as mentioned in this chapter, temporal changes might have accounted for differences between our results and the results of Schuldt and colleagues (2011, 2015, 2017). Thus, we conducted the study reported in Chapter 7 in the same temporal context as the study reported in this chapter.

To summarise, in this chapter we found that there was no interaction between political preferences and question wording on beliefs in the existence of climate change/global warming. However, political polarisations in beliefs did exist, with Conservatives believing less than Liberals in climate change/global warming. This study only examined a single outcome, and operationalisation of political preferences, and was conducted in a different socio-temporal context to the studies conducted by Schuldt and colleagues (2011, 2015, 2017). Furthermore, the role personality traits might have on these associations was not assessed. Thus, in Chapter 7 we performed a study that a) assessed multiple operationalisations of political preferences; b) assessed various pro-environmental attitudes

and behaviours; c) controlled for personality traits; and d) was conducted in a similar socio-temporal context as the study reported in Chapter 6.

Chapter 7: Political Preferences, Personality Traits, and Environmentalism

7.1 Introduction

Despite the widespread scientific evidence, and consensus amongst scientists, for the existence of climate change and global warming (Cook et al., 2016; Hilbig et al., 2013; Intergovernmental Panel on Climate Change, 2018; Klein et al., 2017; Nisbet et al., 2009; Otto et al., 2014; United Nations Environment Programme, 2019), there remain doubts within the general public on these environmental phenomena. Beliefs in climate change's severity varies between geographical regions: for example, 74.0% of Latin Americans believed that it was a serious problem, in contrast 38.0% of Middle Easterners believed that it was a serious problem (Pew, 2015). This scepticism was also found within countries: for example, only 45.0% of Americans believed that global climate change was a serious problem (Pew, 2015), with a similarly high level of scepticism in the UK (41.0%; Pew, 2015). Due to the severity of climate change and its global impact, it is vital to understand what motivates these (dis)beliefs. As one possibility, research had found that scepticism in climate change appeared to be politically polarised, as Conservatives believed less in climate change than Liberals, across several countries (Pew, 2015). A similar divide in beliefs was shown regarding global warming in the USA (Pew, 2017). In turn these political polarisations in beliefs towards environmental issues were found to be reflected in support for environmental policies (Pew, 2015, 2017).

7.1.1 Terminology

When comparing the public's perceptions of environmental phenomena, it was found that Americans were six times more likely than the British, to indicate scepticism towards environmental phenomena (Lorenzoni, Leiserowitz, De Franaca Doria, Poortinga, & Pidgeon, 2006). However, the methodology varied between countries, as American participants were asked about global warming, and British participants about climate change. Although this difference might seem trivial, these phenomena are technically distinct (Schuldt et al., 2017).

However, communication regarding these crucial issues often uses the terms interchangeably (Whitmarsh, 2009), with certain world leaders claiming that climate change was just a rebranding of global warming (e.g. Trump, 2014, 2015).

This difference in terminology was further explored in the UK, where 6.2% of participants had not heard of climate change, whereas all participants had heard of global warming (Whitmarsh, 2009). Furthermore, participants demonstrated a greater knowledge for the impacts of global warming compared to the impacts of climate change, which had been demonstrated elsewhere (e.g. Department for Environment, Food, and Rural Affairs, 2002, 2007; Norton & Leaman, 2004). Furthermore, participants more often associated global warming with human causes, and climate change with natural causes. Lastly, participants evoked stronger concern for global warming than for climate change (Whitmarsh, 2009). Thus, it appeared that for the general public there was a difference in the connotative meanings attached to these terms, despite Whitmarsh having found only 4.0% of people explicitly differentiating between them.

7.1.2 The Impact of Terminology and Operationalisations

These differences in connotative meanings had been suggested to be used for political gain. In 2002, Frank Luntz prepared a memo for the Republican Party on approaching environmental issues (Luntz, 2002). In this memo it was suggested that Republicans should reframe environmental issues by changing the terminology used. For example, Luntz suggested that Republicans use the term climate change as opposed to global warming when discussing environmental issues, as global warming was deemed to be less controllable, more catastrophic, and more emotionally challenging. He argued that simple changes like this could aid Republicans in winning the environmental debate.

Schuldt and colleagues (2011) examined whether terminology could explain the political polarisation of pro-environmental beliefs. This was done by presenting participants, from the USA, with one of two vignettes, and asking how much they believed in the phenomenon presented. These vignettes were identical apart from two minor changes to the wording of the question (presented in brackets):

> You may have heard about the idea that the world's temperature may have been *going up* [*changing*] over the past 100 years, a phenomenon sometimes called '*global warming'* [*'climate change'*]. What is your personal opinion regarding whether or not this has been happening?

It was found that 75.0% of Americans believed in climate change, and 67.7% believed in global warming, a significant difference of 6.3 percentage points. Differences in beliefs were further examined along political preferences, which were operationalised as political self-identifications. Republicans were the only political self-identification that significantly differed in beliefs between these two terms, with 60.2% of Republicans believing in climate change, compared to 44.0% believing in global warming. This effect was replicated in later studies (Schuldt et al., 2015, 2017).

Schuldt and colleagues (2015) expanded upon this and examined whether question wording also influenced people's support for green legislation and beliefs in the scientific consensus on the environmental phenomenon presented. Firstly, the finding that only Republicans demonstrated a difference in beliefs between climate change and global warming existence was replicated. Secondly, there were main effects of question wording and political self-identification on the beliefs in the scientific consensus of environmental phenomena: with global warming eliciting more sceptical beliefs, and Republicans being more sceptical than Democrats. However, there was no interaction between political self-

identification and question wording on the beliefs in the scientific consensus of environmental phenomena. Lastly, when support for green legislation was examined, only the expected difference between Republicans and Democrats was replicated, with no main effect of question wording or an interaction between question wording and political self-identification. But there was a three-way interaction between question order, political self-identification, and question wording, with Republicans being less likely to support green legislation when a) it referred to global warming and b) the question came before the scientific consensus question. No study to our knowledge had expanded upon this finding and examined a wider range of pro-environmental attitudes and behaviours as outcome variables. This formed the first motivation of our study, which was to examine a wide range of pro-environmental attitudes and behaviours as outcome variables.

Regarding the measure of political preferences, Schuldt and colleagues (2015) examined political self-identification on a 7-point scale. Participants were presented with the options of 1 (*Strong Republican*), 2 (*Not Strong Republican*), 3 (*Leans Republican*), 4 (*Undecided/Independent/Other*), 5 (*Leans Democrat*), 6 (*Not Strong Democrat*), and 7 (*Strong Democrat*). However, this was collapsed for their analyses, into Republicans or Democrats, dropping the midpoint response. A later study re-analysed these data, and examined six of the seven categories, again dropping the midpoint response (Morin-Chassé & Lachapelle, 2020). It was found that those who identified strongly as Republicans demonstrated lower levels of beliefs in climate change and global warming compared to any other political self-identification, including those identifying less strongly as Republicans. Furthermore, there were stronger beliefs in climate change than in global warming for those who identified strongly as Republican, leaning toward Republican, and leaning toward Democrat. The remaining political self-identification categories demonstrated no differences in beliefs between the terms. Thus, measuring political self-identification at a more nuanced

level gave greater insight on the effect of question wording and its interaction with political preferences on pro-environmental beliefs. Despite this, no study to our knowledge, had attempted to independently replicate the research of Schuldt and colleagues (2011, 2015, 2017) using a more nuanced measure of political self-identification.

The studies of Schuldt and colleagues (2011, 2015, 2017) examined political preferences in terms of political self-identification, but this does not encapsulate all aspects of political preferences. For example, there is a difference between political self-identification and voting tendencies, with voter turnout being influenced by factors such as knowledge of politics (Delli Carpini & Keeter, 1996), educational attainment (Brady et al., 1995), and campaign techniques (Fisher et al., 2016). Thus, there is a distinction between party voted for and party self-identifications. Despite this, no study to our knowledge had examined other operationalisations of political preferences, in regard to the interaction found by Schuldt and colleagues (2011, 2015, 2017). This further motivated our study, in that we attempted to examine various operationalisations of political preferences. This allowed an assessment of whether the original findings of Schuldt and colleagues (2011) replicated across operationalisations of political preferences.

Several earlier studies suggested that the findings of Schuldt and colleagues (2011, 2015, 2017) might not be universally replicable (Dunlap, 2014; Villar & Krosnick, 2011). However, these studies, unlike Schuldt and colleagues, examined beliefs around the seriousness of climate change and global warming, rather than beliefs around their existence. Although this might seem a trivial difference, these two concepts, although overlapping, are distinct (Krosnick, Holbrook, Lowe, & Visser, 2006; Schuldt et al., 2017). This demonstrated that the interactive effect of question wording and political preferences on pro-environmental beliefs, was limited to certain pro-environmental beliefs. This limitation to certain pro-

environmental beliefs was also found by Schuldt and colleagues (2015). This highlighted the importance of examining the limits of this effect.

7.1.3 Temporal Changes

More recently, a large multi-country replication study of Schuldt and colleagues (2011) was conducted, which examined the original effect and outcome (i.e. existence beliefs; Soutter & Mõttus, 2020). This direct replication found that across three countries (UK, USA, and Australia) that question wording had no impact on existence beliefs, nor did it interact with political self-identification to impact existence beliefs. However, it was consistently found that Conservatives, compared to Liberals, were less likely to believe in climate change and global warming. Thus, the impact of question wording, and its interaction with political preferences, on beliefs in the existence of climate change and global warming may not be universally replicable.

One potential reason for these discrepant results were temporal changes (Soutter & Mõttus, 2020). Since the studies of Schuldt and colleagues (2011, 2015, 2017) major socio-political changes had occurred that might have facilitated changes in the connotative meanings of climate change and global warming (Leiserowitz et al., 2014). For example, only two studies[1] (Schuldt et al., 2017; Soutter & Mõttus, 2020), were conducted after the terms had swapped in popularity, according to Google Trends (2020). Possible temporal changes between studies motivated us to conduct this present study in the same temporal and cultural context as Soutter and Mõttus, in order to rule out these potential confounds.

To briefly summarise, small changes in the pro-environmental beliefs assessed (e.g. problem seriousness versus problem existence) and temporal changes might alter results

[1] Since this study, a third study by Schuldt, Enns, Konrath, and Schwarz (2020) was conducted. Which occured after the terms had swapped in popularity. Its results were in line with Soutter and Mõttus (2020).

regarding the impact question wording and political self-identification had on said beliefs. Furthermore, using varied measures of pro-environmental beliefs and a more nuanced measure of political self-identification provided a greater understanding of partisan differences in beliefs, and potential ways, through terminology, to reduce such differences. Thus, we attempted to perform a conceptual replication of the previous findings (Schuldt et al., 2011, 2015, 2017) and examined more nuanced and varied measures of political preferences and a wide range of pro-environmental attitudes and behaviours, during the same contextual and temporal period as Soutter and Mõttus (2020).

7.1.4 Personality Traits and Environmentalism

One factor that was not accounted for by any of these previous studies, was the potential role of personality traits. Personality traits' associations with political preferences stretches as far back as Aristotle:

> …the various qualities of men are clearly the reason why there are various kinds of states and many forms of government. (Aristotle 350 B.C./1988, p.167)

and had been well-established in modern literature. For example, a meta-analysis that examined how the Big Five was associated with political preferences found that Openness was negatively associated with political conservatism and Conscientiousness was positively associated with it (Sibley et al., 2012).

Personality traits' associations with pro-environmental attitudes and behaviours had also been well-established (e.g. Hirsh, 2010; Hirsh & Dolderman, 2007; Milfont & Sibley, 2012; Nisbet et al., 2009). A recent meta-analysis (Soutter, Bates, & Mõttus, 2020) found that Openness was strongly associated with pro-environmental attitudes and behaviours. Conscientiousness, Agreeableness, and Extraversion were also associated with pro-environmental attitudes and behaviours, but to a lesser extent. Consequently, it might be that

personality traits account for the differences found in pro-environmental beliefs, attitudes, and behaviours between political preferences, rather than political preferences themselves. Despite this apparent connection, few studies had combined political preferences, personality traits, and pro-environmental attitudes and behaviours in the same model (Brick & Lewis, 2016). This formed another motivation for this study.

7.1.5 Present Study

Our primary aim was to conceptually replicate the findings of Schuldt and colleagues (2011, 2015, 2017), and to expand on these early findings in two ways. Firstly, we examined political preferences in two ways, both of which were different to how political preferences were operationalised in these early studies. Secondly, we examined the role of personality traits on the original findings, as well as how political preferences, controlling for personality traits, were associated with several pro-environmental attitudes and behaviours. Lastly, we collected data in a similar temporal and cultural context as Soutter and Mõttus (2020), so as to remove any potential temporal and cultural confounds.

Hypothesis One: An otherwise identical question would elicit lower levels of beliefs when worded in terms of global warming compared to climate change.

Hypothesis Two: There would be no difference in beliefs between global warming and climate change for those who were politically Liberal, while there would be stronger beliefs in climate change, than in global warming, for those who were politically Conservative.

Hypothesis Three: Being politically Liberal, compared to politically Conservative, would be positively associated with pro-environmental attitudes, controlling for personality traits.

Hypothesis Four: Being politically Liberal, compared to politically Conservative, would be positively associated with pro-environmental behaviours, controlling for personality traits.

7.2 Method

Data collection was conducted between the 23rd of January 2018 and the 25th of May 2018, with ethics approval from the PPLS Research Ethics Committee, University of Edinburgh. Data files and our R script can be found at https://osf.io/fe5ms/?view_only=ffddab4cbbcc48318b9a72f67742e8de.

7.2.1 Sample Size

Research suggested that *N* should approach 250 for correlations to stabilise (Schönbrodt & Perugini, 2013). Furthermore, a power analysis for an ANOVA to detect an effect size of 0.2 (a rough average of the effect sizes, 0.14 and 0.35, found by Schuldt and colleagues; 2011), with a power of 0.8 and a critical $\alpha = .05$, with eight groups required approximately 400 participants. For the linear models, the most complex model run would potentially include seven numerical variables, three categorical variables with two levels, a categorical variable with 12 levels, a categorical variable with eight levels, and an interaction. Thus, with a potential 29 predictors, with a power of 0.8, a critical $\alpha = .05$, to find a similar effect size of 0.2, required 144 participants (using WebPower; Zhang & Yuan, 2018). Thus, a sample size of 500 was chosen for this study to ensure an adequate number of participants to detect the hypothesised effects and for correlations to be stabilised.

7.2.2 Participants

Two participants reported their gender as “other”, and due to low representation of this gender group, were removed from further reporting and analyses. British participants (N = 499) were recruited through Prolific, receiving £2.50 for their participation. Pre-screening,

through Prolific, was conducted to ensure an even split of political preferences. The pre-screener asked, “Please indicate where you believe your political ideology lies on this spectrum.” with the responses of “left”, “centre”, “right”, and “N/A”, which we screened on either “left” or “right”. This allowed a balanced design with 222 participants having indicated that they were politically left, 217 politically right, and 60 politically in-between in our study. Two participants stated they voted for Independents, but due to low representation they were grouped with Other for future reporting and analyses. Distribution of demographic variables by question wording was reported in Table 5.

Table 5. Distribution of Demographic Variables by Question Wording

Variable	Overall (*N* = 499)	Climate Change (*N* = 246)	Global Warming (*N* = 253)
	Political Preferences		
Tory	37.9% (189)	38.2% (94)	37.5% (95)
Labour	41.5% (207)	41.5% (102)	41.5% (105)
Other	20.6% (103)	20.3% (50)	20.9% (53)
Political Orientation Mean (Standard Deviation)	3.87 (1.80)	3.85 (1.90)	3.88 (1.69)
	Gender		
Female	60.9% (304)	58.9% (145)	62.8% (159)
	Age (Years)		
Mean (Standard Deviation)	40.40 (12.26)	40.25 (11.90)	40.55 (12.62)
	Area		
Urban	69.3% (346)	67.1% (165)	71.5% (181)
	Education		
Less than High School	0.8% (4)	0.8% (2)	0.8% (2)
High School	18.0% (90)	15.0% (37)	20.9% (53)
Some College	21.8% (109)	23.6% (58)	20.2% (51)
Associate Degree	5.0% (25)	4.9% (12)	5.1% (13)
Bachelor's Degree	38.9% (194)	37.8% (93)	39.9% (101)
Master's Degree	11.6% (58)	13.4% (33)	9.9% (25)
Doctoral Degree	3.4% (17)	4.1% (10)	2.8% (7)
Professional Degree	0.4% (2)	0.4% (1)	0.4% (1)
	Income		
Less than £10,000	5.4% (27)	6.9% (17)	4.0% (10)
£10,000 to £19,999	15.8% (79)	12.6% (31)	19.0% (48)
£20,000 to £29,999	17.8% (89)	16.3% (40)	19.4% (49)
£30,000 to £39,999	20.6% (103)	21.5% (53)	19.8% (50)
£40,000 to £49,999	13.8% (69)	13.8% (34)	13.8% (35)
£50,000 to £59,999	12.2% (61)	15.0% (37)	9.5% (24)
£60,000 to £69,999	4.6% (23)	4.5% (11)	4.7% (12)
£70,000 to £79,999	4.0% (20)	4.1% (10)	4.0% (10)
£80,000 to £89,999	2.0% (10)	2.0% (5)	2.0% (5)
£90,000 to £99,999	1.4% (7)	1.6% (4)	1.2% (3)
£100,000 to £149,999	1.8% (9)	1.6% (4)	2.0% (5)
£150,000 or more	0.4% (2)	0.0% (0)	0.8% (2)

7.2.3 Measures

7.2.3.1 Demographics variables. Participants were initially asked a series of demographic questions regarding their age, country of residence, gender, area (rural or urban), education, and income.

7.2.3.2 Personality traits. The 120-item IPIP-NEO-120 (Johnson, 2014) was used to measure the Big Five personality domains of Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism. Participants indicated their agreement with statements on a 7-point Likert scale, with the responses of 1 (*Strongly disagree*), 2 (*Disagree*), 3 (*Somewhat disagree*), 4 (*Neither agree nor disagree*), 5 (*Somewhat agree*), 6 (*Agree*), and 7 (*Strongly agree*), $\alpha = .86$ to .93.

7.2.3.3 Political preferences. Participants rated their political orientation on a 7-point Likert scale, ranging from 1 (*Very Liberal*) to 7 (*Very Conservative*). This measure was centred on its midpoint of 4 for analyses. Participants were also asked what party they voted for in the last election. These responses were then coded as Tory, Labour, Independent, or Other (with the last two categories being combined due to a lack of Independent voters).

7.2.3.4 Question wording. The wording vignettes were identical to those found in Schuldt and colleagues (2011), see Appendix E.1. Participants read one of these vignettes, framed either as climate change or global warming, and rated on a 7-point Likert scale, with the responses of 1 (*Definitely HAS NOT BEEN happening*), 2 (*Probably HAS NOT BEEN happening*), 3 (*Unsure, but leaning toward it HAS NOT BEEN happening*), 4 (*Not sure either way*), 5 (*Unsure, but leaning toward it HAS BEEN happening*), 6 (*Probably HAS BEEN happening*), and 7 (*Definitely HAS BEEN happening*), their personal opinion regarding whether or not the phenomenon described had been happening.

7.2.3.5 Pro-environmental attitudes. Three measures of pro-environmental attitudes were used. Firstly, the NEP (Dunlap et al., 2000) was used, which required participants to rate their agreement with 15 items on a 5-point Likert scale, with the responses of 1 (*Strongly Disagree*), 2 (*Mildly Disagree*), 3 (*Unsure*), 4 (*Mildly Agree*), and 5 (*Strongly Agree*), $\alpha = .87$. Secondly, the CNS (Mayer & Frantz, 2004) was used, which required participants to rate

their agreement with 14 items on a 5-point Likert scale, ranging from 1 (*Strongly Disagree*) to 5 (*Strongly Agree*), α = .88. Lastly, the ES was used, which required participants to rate their agreement with 38 items on a 5-point Likert scale, with the responses of 1 (*Strongly disagree*), 2 (*Somewhat disagree*), 3 (*Neither agree nor disagree*), 4 (*Somewhat agree*), and 5 (*Strongly agree*), α = .96.

7.2.3.6 Pro-environmental behaviours. Three measures were used to assess pro-environmental behaviours. Firstly, the PEBS (Markle, 2013), a 19-item measure with four subscales (Conservation, Environmental Citizenship, Food, and Transportation), was used, α = .37 to .87. The original rating system was used, except that the driving question added an option of "I do not drive" (scored as the most environmental response) and "I do not know" (scored as the least environmental response). Secondly, a donation measure (Soutter & Boag, 2019) asked participants how they would split £100 spare cash between four options (OXFAM, WWF, BasicNeeds, and keep to spend on self), and gave participants the option to justify their donation split. Lastly, the EB, a 17-item measure, of which only 14 items were used due to a previous factor analysis (see A Correction to Chapter 2), was used. Participants rated how frequently they performed these behaviours on a 5-point Likert scale, with the responses of 1 (*Never*), 2 (*Sometimes*), 3 (*About half the time*), 4 (*Most of the time*), and 5 (*Always*), α = .81. The item asking participants if they drove a fuel-efficient car had the additional option of 6 (*Do not own a car*; scored as the most environmental response).

7.2.3.7 Attention check. The question "I have been to the moon before" was embedded in the personality questionnaire, participants who did not disagree with this item had their data removed.

7.2.4 Procedure

Participants first completed the questions on age, gender, country of residence, area, education, and income followed by the personality trait measure (randomised item presentation). Participants were then randomly assigned (balanced assignment through Qualtrics) to either the climate change or global warming question wording condition. After this, participants completed the pro-environmental attitudes measures (both measures and items within them presented in randomised order) and then the pro-environmental behaviours measures (both measures and items in randomised order; except for the items within the donation measure).

7.3 Results

7.3.1 Hypothesis One

As per the original study (Schuldt et al., 2011), scores for beliefs were transformed into a binary variable. Respondents who rated their beliefs as 5 or above on the Likert scale were coded as believers, and those scoring below 5 were coded as disbelievers.

A chi-square test, with Yates' continuity correction, was performed to assess the difference in endorsements between climate change and global warming. Overall, 83.7% of participants believed in climate change, and 88.9% in global warming, which resulted in a non-significant wording effect χ^2 (1, N = 499) = 2.43, p = .119, V = .07.

7.3.2 Hypothesis Two

7.3.2.1 Party voted for. Beliefs were transformed into a binary variable as in section 7.3.1. A chi-square test, with Yates' continuity correction, was performed to assess if there was a difference in endorsements between climate change and global warming between voters of different political parties. For Tory voters, 76.6% believed in climate change and 83.2% in global warming, which resulted in a non-significant wording effect χ^2 (1, N = 189) =

0.89, $p = .345$, $V = .07$. For Labour voters 92.2% believed in climate change and 94.3% in global warming, which resulted in a non-significant wording effect χ^2 (1, $N = 207$) = 0.11, $p = .739$, $V = .02$. For Other voters 80.0% believed in climate change and 88.7% in global warming, which resulted in a non-significant wording effect χ^2 (1, $N = 103$) = 0.89, $p = .346$, $V = .09$.

A 2 (Condition: global warming versus climate change) x 3 (Political party: Tory, Labour, Other) between-subjects ANOVA tested mean differences in beliefs. No significant interaction was found F (2, 493) = 1.44, $p = .239$, $\eta_p^2 = .01$, thus the interaction was dropped, and the main effects model was examined. There was no effect of question wording F (1, 495) = 0.13, $p = .717$, $\eta_p^2 < .01$. However, there was a significant effect of party voted for F (2, 495) = 19.23, $p < .001$, $\eta_p^2 = .07$. See Table 6 for a summary of group means. These effects remained significant when controlling for the variables of age, gender, area, education, and income. Post-hoc analyses with Bonferroni adjustments, critical $\alpha = .017$, revealed that Tory voters believed less than Labour voters ($p < .001$, $d = .66$), and Other voters ($p = .015$, $d = .26$), and that Labour voters believed more than Other voters ($p = .007$, $d = .31$) in environmental phenomena.

Table 6. Beliefs in Environmental Phenomena

Political	Global Warming		Climate Change		Overall	
Party	*M* [*95%CI*]	*SD*	*M* [*95%CI*]	*SD*	*M* [*95%CI*]	*SD*
Tory	5.66 [5.40, 5.93]	1.31	5.37 [5.08, 5.66]	1.42	5.52 [5.32, 5.71]	1.37
Labour	6.27 [6.08, 6.45]	0.98	6.42 [6.19, 6.65]	1.20	6.34 [6.19, 6.49]	1.09
Other	5.91 [5.51, 6.31]	1.48	5.92 [5.43, 6.41]	1.76	5.91 [5.60, 6.22]	1.62
Overall	5.96 [5.81, 6.12]	1.25	5.92 [5.73, 6.10]	1.48		

An exploratory analysis was conducted to examine whether controlling for personality traits had any impact on the above findings. This did not alter these findings, as seen in Table 7. These effects remained significant when controlling for the variables of age, gender, area, education, and income.

Table 7. Party Voted for and Personality Traits' Associations with Environmental Beliefs

Variable	*F*	ηp^2
Party Voted for	19.97***	.02
Question Wording	0.14	< .01
Party X Question Wording	0.59	< .01
	Personality	
Openness	16.91***	.03
Conscientiousness	1.41	.01
Extraversion	5.99*	.01
Agreeableness	0.27	< .01
Neuroticism	0.32	< .01

Note: *p < .05, **p < .005, ***p < .001

7.3.2.2 Political orientation. For political orientation a multiple linear regression with interaction was performed, with the predictor variables of political orientation and question wording. The interaction model was significant F (3, 495) = 32.36, p < .001, R^2 = .16, f^2 = .20. There was a significant interaction between question wording and political orientation (b = 0.16, SE = 0.06, $95\%CI$ = 0.03, 0.28, p = .013, β = .14). See Figure 1 for a graphical representation of this interaction. This effect remained significant when controlling for the variables of age, gender, area, education, and income. Post-hoc t-tests showed that there was no significant difference in beliefs between climate change and global warming within any level of political orientation.

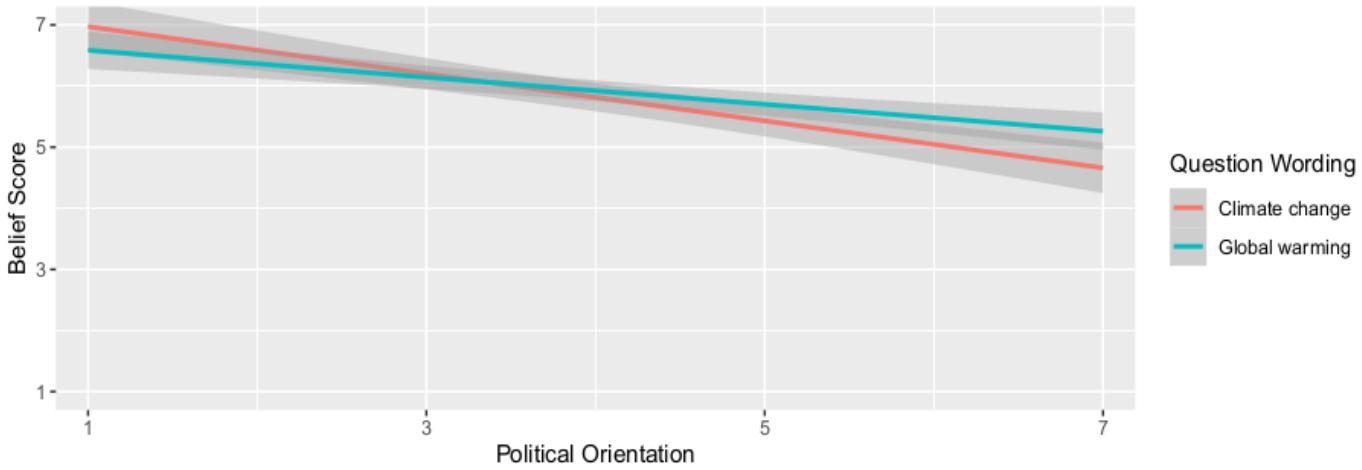

Figure 1. The interaction between political orientation and question wording on beliefs in environmental phenomena. Political orientation ranged from 1 (Very Liberal) to 7 (Very Conservative). Shading reflects 95% confidence intervals.

An exploratory analysis was conducted to examine whether controlling for personality traits had any impact on the above findings. The Big Five domains were added to the model. This did not alter these findings, as seen in Table 8. Only the interaction between political orientation and question wording remained significant when controlling for the variables of age, gender, area, education, and income.

Table 8. Political Orientation and Personality Traits' Associations with Environmental Beliefs

Variable	*B* [95%CI]	*SE B*	β
Political Orientation	-0.33*** [-0.43, -0.23]	.05	-.43
Question Wording	0.09 [-0.13, 0.31]	.11	.03
Political Orientation X Question Wording	0.14* [0.01, 0.26]	.06	.12
Personality			
Openness	0.01 [-0.00, 0.01]	.00	.08
Conscientiousness	0.01* [0.00, 0.02]	.00	.11
Extraversion	-0.00 [-0.01, 0.00]	.00	-.07
Agreeableness	-0.00 [-0.01, 0.01]	.00	-.00
Neuroticism	0.00 [-0.00, 0.01]	.00	.04
F	R^2	f^2	
13.26***	.18	.22	

Note: *$p < .05$, **$p < .005$, ***$p < .001$

7.3.3 Hypotheses Three and Four

As we were concerned with how political preferences were associated with pro-environmental attitudes and behaviours *per say* rather than individual measures (Mõttus, 2016), a single pro-environmental attitudes and behaviours score was created. This was done by standardising each of the pro-environmental attitudes measures, and then taking an average of this to create a total pro-environmental attitudes score. A similar process was done for pro-environmental behaviours.

7.3.3.1 Hypothesis three. Multiple linear regressions were performed with the outcome variable of pro-environmental attitudes, and the predictor variables of political preferences and the Big Five domains.

When operationalising political preferences as party voted for the model was significant F (7, 491) = 26.75, $p < .001$, $R^2 = .28$, $f^2 = .38$. However, there was no effect of party voted for ($p = .410$), with no significant difference between Labour and Tory voters (b = 0.12, SE = 0.09, $95\%CI$ = -0.06, 0.29, $p = .184$, β = .07), Labour and Other voters (b = 0.04, SE = 0.09, $95\%CI$ = -0.14, 0.22, $p = .644$, β = .02), and Other and Tory voters (b = 0.07, SE = 0.10, $95\%CI$ = -0.11, 0.26, $p = .435$, β = .03). Regarding personality traits, Openness (b = 0.02, SE < 0.01, $95\%CI$ = 0.01, 0.02, $p < .001$, β = .39), Conscientiousness (b = 0.01, SE < 0.01, $95\%CI$ = 0.00, 0.01, $p < .001$, β = .17), and Agreeableness (b = 0.01, SE < 0.01, $95\%CI$ = 0.00, 0.01, $p < .001$, β = .17) were significantly associated with pro-environmental attitudes. These associations remained when controlling for age, gender, area, income, and education.

In summary one's voting tendency was not associated with pro-environmental attitudes, whereas higher scores on the personality domains of Openness, Conscientiousness, and Agreeableness were associated with higher pro-environmental attitudes scores.

When operationalising political preferences as political orientation, the model was significant F (6, 492) = 32.29, $p < .001$, $R^2 = .28$, $f^2 = .39$. Political orientation was significantly associated with pro-environmental attitudes (b = -0.06, SE = 0.02, $95\%CI$ = -0.11, -0.01, $p = .013$, β = -.12). Regarding personality traits, Openness (b = 0.02, SE < 0.01, $95\%CI$ = 0.01, 0.02, $p < .001$, β = .35), Conscientiousness (b = 0.01, SE < 0.01, $95\%CI$ = 0.00, 0.01, $p < .001$, β = .18), and Agreeableness (b = 0.01, SE < 0.01, $95\%CI$ = 0.00, 0.01, $p < .001$, β = .16) were significantly associated with pro-environmental attitudes. These associations remained when controlling for age, gender, area, income, and education.

In summary those with a more Liberal political orientation had higher levels of pro-environmental attitudes. Furthermore, higher scores on the personality domains of Openness,

Conscientiousness, and Agreeableness were associated with higher pro-environmental attitudes scores.

7.3.3.2 Hypothesis four. Multiple linear regressions were performed with the outcome variable of pro-environmental behaviours, and the predictor variables of political preferences and the Big Five domains.

When operationalising political preferences as party voted for the model was significant F (7, 491) = 18.99, $p < .001$, $R^2 = .21$, $f^2 = .27$. However, there was no effect of party voted for ($p = .192$), with no significant difference between Labour and Tory voters (b = 0.10, SE = 0.07, $95\%CI$ = -0.03, 0.23, $p = .133$, β = .08), Labour and Other voters (b = -0.02, SE = 0.07, $95\%CI$ = -0.15, 0.12, $p = .798$, β = -.01), and Other and Tory voters (b = 0.12, SE = 0.07, $95\%CI$ = -0.02, 0.25, $p = .102$, β = .08). Regarding personality traits, Openness (b = 0.01, SE < 0.01, $95\%CI$ = 0.01, 0.01, $p < .001$, β = .32), Conscientiousness (b = 0.01, SE < 0.01, $95\%CI$ = 0.00, 0.01, $p = .002$, β = .16), and Agreeableness (b = 0.00, SE < 0.01, $95\%CI$ = 0.00, 0.01, $p = .006$, β = .12) were significantly associated with pro-environmental behaviours. These associations remained when controlling for age, gender, area, income, and education.

In summary one's voting tendency was not associated with pro-environmental behaviours, whereas higher scores on the personality domains of Openness, Conscientiousness, and Agreeableness were associated with higher pro-environmental behaviours scores.

When operationalising political preferences as political orientation, the model was significant F (6, 492) = 22.80, $p < .001$, $R^2 = .22$, $f^2 = .28$. Political orientation was associated with pro-environmental behaviours (b = -0.04, SE = 0.02, $95\%CI$ = -0.08, -0.01, $p = .014$, β = -.13). Regarding personality traits, Openness (b = 0.01, SE < 0.01, $95\%CI$ = 0.01, 0.01, p <

.001, β = .28), Conscientiousness (*b* = 0.01, *SE* < 0.01, *95%CI* = 0.00, 0.01, *p* = .001, β = .16), and Agreeableness (*b* = 0.00, *SE* < 0.01, *95%CI* = 0.00, 0.01, *p* = .010, β = .12) were significantly associated with pro-environmental behaviours. Political orientation and Agreeableness were no longer associated with pro-environmental behaviours, when controlling for age, gender, area, income, and education.

In summary political orientation was not associated with pro-environmental behaviours, whereas higher scores on the personality domains of Openness and Conscientiousness were associated with higher pro-environmental behaviours scores.

7.4 Discussion

7.4.1 Replication

Those with Conservative political preferences were less likely to believe in both climate change and global warming, compared to those with Liberal political preferences, replicating the original findings (Schuldt et al., 2011), as well as the findings of several other studies (Morin-Chassé & Lachapelle, 2020; Schuldt et al., 2015, 2017). But unlike these previous studies, we did not find any evidence that Conservative voters were less likely to believe in global warming than in climate change. It might be argued that this was due to the current study having measured political voting rather than self-identification, like these previous studies. The lack of a difference in belief between global warming and climate change for Conservative voters, however, was consistent with the findings of Soutter and Mõttus (2020) and Schuldt, Enns, Konrath, and Schwarz (2020), who measured political self-identification.

When political orientation was examined there was a significant interaction, but this appeared to go in the opposite direction to that originally found (Morin-Chassé & Lachapelle, 2020; Schuldt et al., 2011, 2015, 2017). However, it was found that within each level of

political orientation there was no significant difference in beliefs between climate change and global warming. This counter-hypothesised interaction suggested several things. Firstly, it highlighted the importance of studying political preferences on a more nuanced, continuous measure (i.e. political orientation), as doing so revealed potentially important differences compared to when political preferences were examined as discrete categories (i.e. party voted for). Secondly, it pointed to a potential reversal of the original findings of Schuldt and colleagues (2011, 2015, 2017). This might be due to changes in the connotative meanings of these terms, as climate change had become a more popular term in public discourse since the original study by Schuldt and colleagues (2011). However, it is important to replicate this result, with larger samples before drawing too much on this interaction. Especially as some of these individual levels of political orientation were underrepresented (e.g. there were only eight strongly Conservative individuals who read the global warming vignette).

Collectively these findings provided further evidence that temporal changes might have accounted for differences in results, between this study, and by extension Soutter and Mõttus (2020), and the studies of Schuldt and colleagues (2011, 2015, 2017). The connotative meanings of climate change and global warming are dynamic and can change rapidly, and with continued use climate change might supplant global warming in its dominance in the public discourse (Leiserowitz et al., 2014). The latter part of this argument appeared to be supported. According to Google Trends (2020) global warming was the preferred term for the general public worldwide, including during the data collection of Schuldt and colleagues (2011, 2015). In March 2015 climate change became a more popular term than global warming and was consistently so since July 2016. Of the studies that found a difference in beliefs between climate change and global warming as a function of political preferences, only Schuldt and colleagues (2017) collected data after this change in the terms' relative popularity. This pointed to a potential reason for why there was no longer a

difference in beliefs between these terms. As the connotative meanings of these terms might have altered as the popularity of these terms reversed.

Soutter and Mõttus (2020) also argued that several socio-political changes had occurred since the original studies (Schuldt et al., 2011, 2015, 2017) and their replication, that by extension apply to this present study. For example, the previous studies were all conducted during Obama's presidency, while Soutter and Mõttus, and this present study, were conducted during Donald Trump's presidency, who is a well-known climate change sceptic (e.g. Trump, 2013, 2014, 2017, 2018). Although this present study was conducted in the UK, similar socio-political changes had occurred (e.g. Brexit and a shift towards the right in politics). It could be argued that the contextual differences between the UK and the USA might have explained why no effect of question wording was found. However, the results of this present study were consistent with the findings of Soutter and Mõttus (2020) and Schuldt and colleagues (2020) who found no effect of question wording in the USA in a more recent context.

There were however sampling differences between this present study, and Soutter and Mõttus (2020), and the previous studies of Schuldt and colleagues (2011, 2015, 2017). The predominant difference being that this present study and Soutter and Mõttus used convenience samples collected from various online sources, whereas Schuldt and colleagues used representative sampling. However, in a recent analysis, using data collected during the same time as this present study, using a representative sample, Schuldt and colleagues (2020) found no significant interaction between question wording and political preferences on beliefs in the existence of global warming and climate change.

Taken together, these points suggested that it was likely that temporal changes accounted for the differences in findings, rather than country or sampling differences.

Another possible reason for why this study's results differ from Schuldt and colleagues (2011, 2015, 2017) was how political preferences were measured.

7.4.2 Measurement of Political Preferences

Schuldt and colleagues (2011) measured political preferences via a discrete choice question, in which participants chose which party they most identified with (Republican, Democrat, Independent, or Other). The follow-up studies of Schuldt and colleagues (2015, 2017) altered this question to be on a numerical scale from 1 (*Strong Republican*) to 7 (*Strong Democrat*), with 4 (*Undecided/Independent/Other*) as the midpoint, however these were then collapsed into the categories of Republican and Democrat, with the 2017 study keeping the category of Independent. A re-analysis of Schuldt and colleagues (2015), that did not collapse these categories, replicated the results of Schuldt and colleagues (2015; Morin-Chassé & Lachapelle, 2020). However, this present study operationalised political preferences in two separate ways.

Firstly, we operationalised political preferences as the party that participants had voted for in the last election. We assessed party voted for, rather than party self-identification, as we were interested in the former, as voters determine which party, and subsequently which environmental policies, are in power. Our second operationalisation did however assess self-identification, although not in party categories, as we asked participants, on a continuous scale, what their political orientation was from 1 (*Very Liberal*) to 7 (*Very Conservative*).

Although these differences in operationalisations could be argued to explain the differences in findings, the results of this study were consistent with those of Soutter and Mõttus (2020) and Schuldt and colleagues (2020) who operationalised political preferences similarly to previous studies (Schuldt et al., 2011, 2015, 2017). Thus, it was unlikely that

these different operationalisations of political preferences were solely accountable for the differences in findings.

Although the effect of question wording was not found, there was a consistent finding that those who voted for a left-leaning party, or had a more Liberal political orientation, tended to believe in climate change/global warming more than those who voted for a right-leaning party, or had a more Conservative political orientation.

7.4.3 Political Preferences and Pro-Environmental Attitudes and Behaviours

Political preferences were inconsistently associated with pro-environmental attitudes and behaviours. It was found that when political preferences were operationalised as party voted for, political preferences were not associated with pro-environmental attitudes and behaviours, when controlling for personality traits. In contrast, when operationalised as political orientation, it was found that those with a more Liberal orientation had higher levels of pro-environmental attitudes and behaviours, when controlling for personality traits. However, political orientation was no longer associated with pro-environmental behaviours when further controlling for the variables of age, gender, area, income, and education.

Political orientation's significant associations with pro-environmental attitudes and behaviours were consistent with past research. For example, a recent meta-analysis demonstrated that both party affiliation and political ideology were associated with pro-environmental concerns (Cruz, 2017). The finding that political party voted for was not associated with pro-environmental attitudes and behaviours was not in line with this past research. However, there is a difference between political self-identification and party voted for. Thus, future research in this area should operationalise political preferences both as voting tendencies and self-identification/orientation. This is because the results here

demonstrated that political preferences' associations with pro-environmental attitudes and behaviours were impacted by how political preferences were operationalised.

7.4.4 The Impact of Personality Traits

This study built upon past research that had examined how political preferences were associated with pro-environmental beliefs, attitudes, and behaviours. This was done by examining the role of personality traits alongside these associations. The reason for doing so was twofold. Firstly, personality traits had been associated with pro-environmental attitudes and behaviours (e.g. Hirsh, 2010; Hirsh & Dolderman, 2007; Milfont & Sibley, 2012; Nisbet et al., 2009; Soutter et al., 2020). Secondly, there is a long history (e.g. Aristotle 350 B.C./1988), and modern findings (Sibley et al., 2012) of personality traits being associated with political preferences. Due to these associations, it might be that the associations found between political preferences and pro-environmental beliefs, attitudes, and behaviours, were confounded by differences in personality traits. Thus, it is important to examine whether past findings that found an association between political preferences and beliefs in climate change and global warming (Morin-Chassé & Lachapelle, 2020; Schuldt et al., 2011, 2015, 2017; Soutter & Mõttus, 2020) remained when controlling for personality traits.

Regarding this potential confounding, it was found that personality traits did not impact the associations between question wording and political preferences on beliefs in climate change/global warming. Furthermore, it was found that political preferences, when operationalised as party voted for, were not associated with pro-environmental attitudes and behaviours when controlling for personality traits. However, when operationalised as political orientation, political preferences were significantly associated with pro-environmental attitudes and behaviours when controlling for personality traits. It must be noted that political orientation's association with pro-environmental behaviours was not significant when further controlling for age, gender, area, income, and education.

7.4.5 Implications for Research and Policy

These findings provided several potential implications for future research and policy. Firstly, this study further reinforced the results of Soutter and Mõttus (2020), that the results of Schuldt and colleagues (2011, 2015, 2017) were temporally bound. Thus, although not an intended consequence of Schuldt and colleagues' results, their results may no longer provide a cost-efficient intervention for reducing scepticism towards environmental issues. Instead other avenues should be explored for how to reduce this partisan divide in pro-environmental beliefs, attitudes, and behaviours. Although, if indeed temporal changes accounted for the differences between our results and the results of Schuldt and colleagues (2011, 2015, 2017), the results of this study might too be temporally bound. It might be that as the term climate change becomes more commonly used, it becomes seen as a separate issue to global warming. This distancing might again lead to a difference in beliefs between these two terms. Although no differences in beliefs on these phenomena were found in this study, it had been found by others that individuals associated global warming more regularly with human activities and climate change with natural processes (Schuldt et al., 2020). As a result, research and policy that use terminology framing as an intervention to promote pro-environmental beliefs, attitudes, and behaviours must be frequently updated to ensure their effectiveness.

Political preferences' interaction with question wording on beliefs in climate change/global warming, and its associations with pro-environmental attitudes and behaviours, varied based on its operationalisation. Thus, it is critical that future research includes multiple operationalisations of political preferences, as this provided greater insight on political preferences' associations with pro-environmental beliefs, attitudes, and behaviours.

Lastly, this study demonstrated that the combination of personality traits and political preferences provided a greater insight into differences in pro-environmental attitudes and

behaviours. Thus, research should focus on the impact these variables combined could have on pro-environmental attitudes and behaviours. Although political preferences were no longer associated with pro-environmental behaviours when age, gender, area, income, and education were further controlled for, future studies should examine if this is robust across various pro-environmental behaviours.

These findings could provide potential real-world implications for policy interventions, which might be better focused on targeting individuals who are both politically Conservative, and low in Openness, Conscientiousness, and Agreeableness. For example, policy promoting renewable energy, could focus on the financial benefits it provides the local area, and country, and how this would reduce reliance on foreign sources of energy. Doing so would appeal to Conservative values such as in-group loyalty, while not focusing on the morality of the action, which would not appeal to those low in Openness and Agreeableness. This re-framing of traditionally Liberal issues (e.g. Obamacare or same-sex marriage) in terms that appealed to Conservative morals had been found to be effective at increasing support amongst Conservatives for these issues (Feinberg & Willer, 2015). Furthermore, some recent work in the European Union suggested that those who were economically right-leaning were more likely to donate money to offset carbon (Azarova et al., 2019).

7.5 Conclusion

Our study added additional insight on a potential interactive effect between political preferences and question wording on people's beliefs in environmental phenomena. We replicated the partisan differences in beliefs in the existence of climate change/global warming, with Conservatives believing less in these phenomena than Liberals. Furthermore, these partisan differences partially extended to other pro-environmental attitudes and behaviours. The impact of question wording (i.e. climate change versus global warming), and its interaction with political preferences may no longer be relevant for beliefs in the existence

of climate change/global warming. However, additional research should examine other ways to reduce partisan divides in pro-environmental beliefs, attitudes, and behaviours. This could be done by reframing current environmental issues in ways that appeal to those who are low in Openness, Conscientiousness, and Agreeableness, and hold Conservative political preferences.

Chapter 8: A General Discussion

8.1 Summary of Key Findings

This dissertation primarily concerned itself with the examination of what types of people do (not) care or act pro-environmentally and examined or suggested potential mechanisms for promoting pro-environmental attitudes and behaviours. Within this broad topic, this dissertation focused on how the individual differences of personality and political preferences were associated and could be used to promote pro-environmental attitudes and behaviours.

Chapter 1 of this dissertation presented a broad introduction on the history and development of environmental and conservation psychology, and how various disciplines within psychology contributed to these emerging disciplines. In the chapters that followed this introduction we presented the empirical findings of several studies. These chapters and the studies they report can be broken into three parts.

8.1.1 On Measuring Pro-Environmental Attitudes and Behaviours

Part 1 of this dissertation focused on ways to measure pro-environmental attitudes and behaviours. In Chapter 2, two unidimensional measures, the ES to measure pro-environmental attitudes and the EB to measure pro-environmental behaviours, were created. These measures were created in order to address issues with existing measures of pro-environmental attitudes and behaviours.

Regarding pro-environmental behaviours there is an overabundance of measures, with most studies using their own unique measure of it (Markle, 2013). This was problematic as the lack of a consistent measurement of pro-environmental behaviours in the literature prevented studies from being easily compared (Kaiser, 1998; Levine & Strube, 2012; Markle, 2013; Walton & Austin, 2011). Thus, a general measure of pro-environmental behaviours which could be widely used in the literature was needed. However, there are only a few general measures of pro-environmental behaviours (Kaiser, 1998; Markle, 2013). These had

several limitations and were not widely used in the literature, as shown in Chapter 4's literature search. The EB was created to address this and provide a general measure of pro-environmental behaviours. This measure demonstrated concurrent validity in Chapter 2, which was further reinforced in Chapter 3.

Pro-environmental attitudes similarly suffer from an overabundance of measures, with no clear gold-standard (Dunlap & Jones, 2002; Milfont & Duckitt, 2010; Stern, 1992). Although no gold-standard currently exists, the NEP was found to be a widely used measure (Fransson & Gärling, 1999; Milfont & Duckitt, 2010), however it was criticised for being an overly cognitive measure of pro-environmental attitudes (Hirsh & Dolderman, 2007). Thus, the NEP perhaps ignored the emotive aspects of pro-environmental attitudes which were found to be strongly associated with pro-environmental behaviours (Kals et al., 1999). It had been demonstrated that combining the NEP with measures that tap into the emotive aspects of pro-environmental attitudes, improved pro-environmental attitudes' association with pro-environmental behaviours (Frantz & Mayer, 2014; Markowitz et al., 2012; Rauwald & Moore, 2002). This combining of cognitive and emotive aspects into a single measure was what the ES was designed to do. In Chapter 2 it was found that the ES was strongly associated with two measures of pro-environmental behaviours, potentially indicating predictive validity. In Chapter 3 the psychometric properties of the ES were further assessed, and it demonstrated acceptable to good internal consistency, test-retest reliability, and predictive validity for pro-environmental behaviours on par with other existing measures of pro-environmental attitudes. Furthermore, it demonstrated concurrent validity with existing measures of pro-environmental attitudes.

Despite the psychometric properties of the ES and EB being assessed within these chapters as being good, there is the question of what contribution these measures had to the field. As outlined previously there is an anarchy of measurement when it comes to the

number of measures to assess pro-environmental attitudes and behaviours (Markle, 2013; Stern, 1992). Undoubtedly, the creation of the ES and EB negatively contributed to this, adding another set of measures to the existing pool of measures. This was indeed a limitation of creating a new set of measures. Ideally, if we could have collected enough participants, these two new measures would be factor analysed alongside existing measures. This would create a new pro-environmental attitudes and behaviours measure that took the best items, in terms of reliability and validity, from these various measures to create gold-standard measures of general pro-environmental attitudes and behaviours. However, we were not able to achieve this, and ultimately chose instead to focus our efforts on examining what individual differences were associated and could be used to promote pro-environmental attitudes and behaviours. Despite contributing to the anarchy of measurement, these two measures do have their benefits.

As outlined previously existing measures of pro-environmental attitudes appeared to focus on either the cognitive or emotive aspects of pro-environmental attitudes. Furthermore, the combination of cognitive and emotive measures appeared to improve one's understanding of pro-environmental behaviours (e.g. Frantz & Mayer, 2014; Markowitz et al., 2012; Rauwald & Moore, 2002). Thus, the ES was a beneficial measure as it assessed both these aspects of pro-environmental attitudes. Furthermore, the utility of doing so was demonstrated by the ES being one of the best measures in terms of predictive validity for pro-environmental behaviours. Regarding pro-environmental behaviours, the EB was a general measure that assessed similar behaviours to existing measures of pro-environmental behaviours, the GEB and PEBS. However, it also assessed behaviours that were not already covered by these measures. In summary while these new measures contributed negatively to the anarchy of measurement, they were useful and should be used alongside existing measures to create a more holistic understanding of pro-environmental attitudes and

behaviours. Ultimately though, greater work is needed in the fields of environmental and conservation psychology to reduce the number of measures used, while measuring an adequate breadth of pro-environmental attitudes and behaviours. For example, instead of using the EB, GEB, or PEBS, a measure should be created that combines these pro-environmental behaviours measures, and includes behaviours not covered by these measures.

Chapter 3 further assessed the test-retest reliability, internal consistency, and predictive validity for pro-environmental behaviours of several existing pro-environmental attitudes measures in order to determine which would be the best to use in future studies. The NEP demonstrated the best test-retest reliability but was somewhat limited in its predictive validity for pro-environmental behaviours. The EAI, ECS, ES, and CNS demonstrated acceptable to good test-retest reliability, internal consistency, and predictive validity for pro-environmental behaviours. Thus, Chapter 3 contributed to the literature and the studies reported in Part 2 and 3 of this dissertation, by providing a single source that examined the psychometric properties of several existing pro-environmental attitudes measures. This allowed researchers to make informed decisions on which measure(s) to use to assess pro-environmental attitudes. Having established the psychometric properties of several measures of pro-environmental attitudes, this dissertation then examined how individual differences were associated with pro-environmental attitudes and behaviours.

8.1.2 On Personality and Pro-Environmental Attitudes and Behaviours

Part 2 of this dissertation focused on personality, an aspect of individual differences. Chapter 4 examined, via a meta-analysis, how the broad domains of the Big Five and HEXACO were associated with pro-environmental attitudes and behaviours. Chapter 5 expanded on this and examined these associations at a narrower level. This was done by examining how the facets of the Big Five were associated with pro-environmental attitudes and behaviours. Lastly, in Part 3 Chapter 7, personality and political preferences were

modelled together, as this allowed an examination of their associations with pro-environmental attitudes and behaviours while controlling for each other. These findings and their fit within the literature will now be briefly discussed, with more in-depth discussions found in Chapter 4, 5, and 7.

Honesty-Humility was found in Chapter 4 to be strongly and positively associated with pro-environmental attitudes and behaviours. This domain was designed to assess the degree to which individuals are cooperative with and avoid exploiting others (Ashton et al., 2014; Lee et al., 2015). Cooperating with others is required for collective pro-environmental behaviours, which are required to effectively tackle environmental issues, such as climate change. Researchers also suggested that pro-social motivations may help form people's pro-environmental attitudes and behaviours (Heberlein, 1972; Lee et al., 2015; Stern, 2000). Furthermore, humanity's exploitation of the natural environment has led to many environmental issues, such as climate change (Cook et al., 2016). Therefore, a desire to avoid exploiting others should facilitate pro-environmental attitudes and behaviours. For these reasons, Honesty-Humility's associations with pro-environmental attitudes and behaviours were to be expected and were theoretically reasonable.

The HEXACO was not assessed in Chapter 5 so no conclusions could be made regarding how Honesty-Humility's facets were associated with pro-environmental attitudes and behaviours. The little research on how Honesty-Humility's facets were associated with pro-environmental attitudes and behaviours suggested that the facet of Greed Avoidance might drive Honesty-Humility's associations with pro-environmental attitudes and behaviours (Brick & Lewis, 2016; Markowitz et al., 2012). Furthermore, this dissertation did not assess the HEXACO alongside political preferences. A study that had, demonstrated that Honesty-Humility was no longer associated with pro-environmental behaviours, when controlling for political preferences (Brick & Lewis, 2016). Further research is needed on

how the facets of Honesty-Humility could be associated with pro-environmental attitudes and behaviours, and how Honesty-Humility could be associated with these attitudes and behaviours, when controlling for political preferences.

Openness was also found to be strongly and positively associated with pro-environmental attitudes and behaviours in Chapter 4 and remained so when controlling for political preferences in Chapter 7. One theory for these associations was because Openness had been associated with cognitive ability (Ackerman & Heggestad, 1997), particularly crystallised intelligence (Ashton, Lee, Vernon, & Jang, 2000; Bates & Shieles, 2003). It might be the case that individuals high in Openness act and think more pro-environmentally, due a greater knowledge and understanding of humanity's impacts on the natural environment. It had also been argued that people high in Openness would be more willing to accept and adopt new ideas (Hirsh, 2014) and be more tolerant towards outgroups (Lee et al., 2015). This would likely facilitate pro-environmental attitudes and behaviours which tend to push against conventional ideas of humanity's interaction with the natural environment. Furthermore, a greater tolerance of the out-group, which other species, kingdoms of life, and the wider environment are, would facilitate these pro-environmental attitudes and behaviours. Lastly, Openness had been associated with an appreciation of aesthetics, which had been argued to foster an aesthetic appreciation of nature, which in turn motivates individuals high in Openness to preserve nature (Hirsh & Dolderman, 2007).

In Chapter 5 we examined which facets of Openness were driving Openness' associations with pro-environmental attitudes and behaviours. It was found that all the facets of Openness were positively associated with pro-environmental attitudes and behaviours, except for Imagination which was not associated with pro-environmental behaviours. The facet of Artistic Interests was strongly associated with pro-environmental attitudes and behaviours. This was in line with the limited research in this area (e.g. Markowitz et al.,

2012), and appeared to support the notion that fostering an aesthetic appreciation with nature motivates individuals to want to preserve nature (Hirsh & Dolderman, 2007). The facet of Intellect was also strongly associated with pro-environmental attitudes and behaviours. This supported the idea that a greater understanding of humanity's impacts on the natural environment fosters pro-environmental attitudes and behaviours. Liberalism (i.e. challenging of authority; Johnson, 2020) was also strongly associated with pro-environmental attitudes and behaviours. Past research had demonstrated that this unconventionality was only associated with pro-environmental attitudes and not pro-environmental behaviours (Brick & Lewis, 2016). However, the rise of worldwide movements (e.g. Extinction Rebellion) that aim to challenge authority and humanity's current relationship with nature might account for this changing association between unconventionality and pro-environmental behaviours. Furthermore, it might be that the behaviors we examined were more in line with unconventionality as opposed to those behaviors examined by Brick and Lewis. For example, we assessed behaviours such as political support and protesting, whereas Brick and Lewis did not.

The domain of Agreeableness was found to be positively associated with pro-environmental attitudes and behaviours, but to a weaker extent than Openness and Honesty-Humility, in Chapter 4. It remained associated with pro-environmental attitudes and behaviours when controlling for political preferences in Chapter 7. However, in Chapter 7, Agreeableness was inconsistently associated with pro-environmental behaviours when further controlling for age, gender, area, income, and education. Agreeableness had been associated with greater levels of empathy and compassion (Graziano & Eisenberg, 1997). The ability to empathise and be compassionate were suggested to be major predictors of pro-environmental behaviours (Schultz, 2000). That Agreeableness was associated with pro-environmental attitudes and behaviours, was thus, to be expected, as environmentalism requires empathy

and compassion for other species and the wider environment, as well as for future generations who are the most likely to be affected by environmental phenomena like climate change. In Chapter 5 we examined which facets of Agreeableness were driving Agreeableness' associations with pro-environmental attitudes and behaviours. It was found that the facets of Agreeableness were positively associated with pro-environmental attitudes and behaviours. Trust was the one exception to this, which was not associated with pro-environmental attitudes and behaviours. Sympathy and Altruism were strongly associated with pro-environmental attitudes and behaviours. This supported the idea that people act pro-environmentally due to empathic and compassionate motivations (Markowitz et al., 2012; Schultz, 2001).

Conscientiousness was found to be positively associated with pro-environmental attitudes and behaviours, to a similar extent as Agreeableness, in Chapter 4. Conscientiousness remained associated with pro-environmental attitudes and behaviours when controlling for political preferences in Chapter 7. These associations were suggested to be because people high in Conscientiousness tend to be self-disciplined (Markowitz et al., 2012). Self-discipline and perseverance are required for meaningful pro-environmental behaviours, which require repetition over time and contexts to have a meaningful impact on tackling environmental issues. In contrast, people high in Conscientiousness also tend to be more traditional in their behaviours, which would be counter to many pro-environmental behaviours. These are examples, of why Conscientiousness was suggested in the literature to be inconsistently associated with pro-environmental attitudes and behaviours (Markowitz et al., 2012). However, the results of the meta-analysis suggested that despite these potential inconsistencies, Conscientiousness was positively associated with pro-environmental attitudes and behaviours. It might be the case though, that certain facets of this domain are

negatively or not associated with pro-environmental attitudes and behaviours, which would result in a weaker association at the domain-level where facets are aggregated.

In Chapter 5 we examined how the facets of Conscientiousness were associated with pro-environmental attitudes and behaviours. It was found that no facets of Conscientiousness were negatively associated with pro-environmental attitudes and behaviours. However, Cautiousness was not associated with pro-environmental attitudes and behaviours. Furthermore, Orderliness and Self-Discipline were not associated with pro-environmental attitudes but were associated with pro-environmental behaviours. Orderliness' inconsistent associations were in line with past research, which had tended to find this facet to be inconsistently associated with pro-environmental attitudes and behaviours (Markowitz et al., 2012; White & Hyde, 2012). That Self-Discipline was not associated with pro-environmental attitudes was not consistent with previous literature, which had found that similar concepts to Self-Discipline were associated with pro-environmental attitudes (e.g. Brick & Lewis, 2016; Markowitz et al., 2012). This might have been due to the strict adjustments made for multiple comparisons, as it was significant at $p < .010$. Further research is needed to determine if and how Self-Discipline could be associated with pro-environmental attitudes. The remaining facets that would facilitate repeated behaviours (i.e. Achievement Striving, Dutifulness, and Self-Efficacy) were however positively associated with both pro-environmental attitudes and behaviours.

Extraversion was found to be positively associated with pro-environmental attitudes and behaviours in Chapter 4, to a slightly weaker extent than Agreeableness and Conscientiousness. In Chapter 7 Extraversion was only found to be associated with beliefs in the existence of climate change/global warming, when controlling for political preferences as operationalised as party voted for, but not when operationalised as political orientation. Furthermore, Extraversion was not associated with pro-environmental attitudes and

behaviours when controlling for political preferences in Chapter 7. These findings perhaps reflected the weaker associations found in Chapter 4 between Extraversion and pro-environmental attitudes and behaviours. Those high in Extraversion are often characterised as being highly social, active, and person-orientated (McCrae & Costa, 1999). It might be the case that this desire to engage with others and in activities would be associated with pro-environmental behaviours such as joining pro-environmental organisations and groups, or behaviours that increase pro-environmental awareness (e.g. being outdoors). This engagement in pro-environmental behaviours and the natural environment might then in turn foster pro-environmental attitudes. Furthermore, literature had suggested that those high in Extraversion tended to be high in self-expression and low in fate control, both of which had been associated with pro-environmental behaviours (Inglehart & Baker, 2000; Leung & Bond, 2004).

Chapter 5 examined what facets of Extraversion were associated with pro-environmental attitudes and behaviours. In contrast to Chapter 4, Extraversion was not associated with pro-environmental attitudes at a domain level. Furthermore, none of its facets were associated with pro-environmental attitudes. This finding perhaps reflected the weaker association found in Chapter 4 between Extraversion and pro-environmental attitudes. It was found that the facets of Activity Level and Cheerfulness were positively associated with pro-environmental behaviours. These associations supported the idea that it was perhaps the active engagement with the natural environment that lead to pro-environmental behaviours. The results of Chapter 5 suggested that this does not then go on to foster pro-environmental attitudes in these individuals. However, the expected domain-level association of Extraversion with pro-environmental attitudes was not found, which might explain why no facet-level associations were found. Further research is needed, as it might be the case that

people who are more active outside, enjoy doing activities in nature, and this then fosters a desire to protect nature.

Lastly, Neuroticism was found to not be associated with pro-environmental attitudes and behaviours in Chapter 4, which was further supported in Chapter 7. This was not too surprising as the literature finds Neuroticism to be inconsistently associated with pro-environmental attitudes and behaviours, even within the same study (e.g. Milfont & Sibley, 2012). In Chapter 5 we examined if any facets of Neuroticism were associated with pro-environmental attitudes and behaviours, which might be masked when facets are aggregated at the domain-level. The only significant association found was a negative one between Immoderation and pro-environmental behaviours. Taken together these results demonstrated that Neuroticism is unlikely to play a role in understanding pro-environmental attitudes and behaviours.

While we examined these personality traits individually, we also examined how they collectively could be used to predict pro-environmental attitudes and behaviours. In Chapter 4 we found that collectively the domain-level associations of the Big Five provided substantial predictive ability for pro-environmental attitudes and behaviours in holdout datasets. In Chapter 5 we continued this examination and further demonstrated the ability to predict pro-environmental attitudes and behaviours from domains. Furthermore, we demonstrated that the facet-level associations provided a similar level of predictive value for pro-environmental attitudes and behaviours. The finding that facets provided no additional predictive value was counter to research in other areas, which had demonstrated that understanding personality traits at a narrower level provided a greater predictive value of outcomes (e.g. Mõttus & Rozgonjuk, 2019).

8.1.3 On Political Preferences and Pro-Environmental Attitudes and Behaviours

Another individual difference that this dissertation examined was political preferences and how they were associated and could be used to promote pro-environmental attitudes and behaviours. In Chapter 6 we performed a direct replication of a past study (Schuldt et al., 2011), which examined how political preferences and question wording interacted to influence beliefs in environmental phenomena. Furthermore, we extended the replication to two other countries (UK and Australia). In Chapter 7 we performed a conceptual replication of a past study (Schuldt et al., 2011), which examined varied operationalisations of political preferences, and a wider set of pro-environmental attitudes and behaviours, while controlling for personality traits.

The original finding, that political preferences interacted with question wording to influence beliefs in the existence of climate change and global warming, no longer replicated across these two chapters. An interaction between political preferences and question wording was found in Chapter 7, when political preferences were operationalised as political orientation (i.e. on a continuous scale). This, however, was in the opposite direction to that found by Schuldt and colleagues (2011, 2015, 2017). Furthermore, there was no effect of question wording on beliefs in environmental phenomena (i.e. there was no difference in beliefs in the existence of climate change and global warming within any sample). In Chapter 6 and 7 it was suggested that the inability to replicate these effects might be due to differences in the socio-temporal context between these two replications and the original studies (Schuldt et al., 2011, 2015, 2017). This was supported by Schuldt and colleagues (2020) who no longer found an interaction between question wording and political preferences in beliefs in the existence of climate change and global warming, when studied in the same socio-temporal context as our replications. It was possible that the connotative meanings behind these terms shifted over time as Leiserowitz and colleagues (2014) argued.

This shift in connotative meanings might then account for the differences in findings between our replications and the original studies. Furthermore, it was found that controlling for personality traits had no impact on these findings.

Although the effect of question wording and its interaction with political preferences on beliefs in environmental phenomena was not replicated, the association political preferences had with pro-environmental beliefs was replicated. In Chapter 6 and 7 it was found that Liberals were more likely to believe in climate change/global warming than Conservatives, which was consistent with the wider literature (e.g. Pew, 2015, 2017; Schuldt et al., 2011, 2015, 2017). In Chapter 7 this association was further examined, and it was found that political preferences, when operationalised as political orientation (i.e. on a continuous scale), were associated with pro-environmental attitudes and behaviours when controlling for personality traits. The combination of personality and political preferences in understanding pro-environmental attitudes and behaviours might seem an obvious one, considering the connection between these variables (Sibley et al., 2012; Soutter et al., 2020). However, the modelling of these variables together had only been done recently (Brick & Lewis, 2016). The results of Chapter 7 demonstrated that political preferences, when operationalised as political orientation, could be uniquely associated with pro-environmental attitudes and behaviours when controlling for personality. However, it was not associated with pro-environmental behaviours when further controlling for age, gender, area lived in, income, and education. Furthermore, political preferences, when operationalised as party voted for, were not associated with pro-environmental attitudes and behaviours when controlling for personality traits. This suggested that the operationalisation of variables, in particular political preferences, could have meaningful impacts on understanding pro-environmental attitudes and behaviours.

The work in these two chapters highlighted the importance of replicating and examining potential interventions to promote pro-environmental attitudes and behaviours, as they may be temporally bound. This can be seen in other areas, for example, past studies demonstrated that right-leaning economic beliefs were negatively associated with pro-environmental attitudes (Allen et al., 2007), but more recent work had shown that right-leaning economic beliefs were positively associated with pro-environmental behaviours (Azarova et al., 2019). It is important that mechanisms for promoting pro-environmental attitudes and behaviours are periodically and frequently re-evaluated, in order for interventions relying on these mechanisms to be efficient at achieving their goals. Lastly, these chapters also showed the importance of not only examining personality and political preferences together, but also the importance and impact different operationalisations of political preferences could have on understanding pro-environmental attitudes and behaviours.

8.2 Limitations

This dissertation provided several valuable contributions to the disciplines of environmental and conservation psychology. However, as with all research there were several limitations that need to be considered. These limitations will now be discussed.

Regarding the measurement of pro-environmental attitudes and behaviours in Part 1, there were several limitations that need to be considered. Firstly, the sample size used in Chapter 2 for the factor analysis was limited, and a larger sample size would be required to confirm the structure we found for the ES and EB measures. Despite this limitation, the ES demonstrated good test-retest reliability, internal consistency, and predictive validity for pro-environmental behaviours on par with other existing measures of pro-environmental attitudes. Furthermore, it demonstrated concurrent validity with existing measures of pro-environmental attitudes. This demonstrated that it was a psychometrically sound measure of

pro-environmental attitudes. Similarly, the EB demonstrated good concurrent validity with other pro-environmental behaviours. Another issue with our factor analysis was that we focused on a simple structure of pro-environmental attitudes. Although the exact structure of pro-environmental attitudes had been debated in the literature, there was some evidence for a hierarchical structure (Milfont & Duckitt, 2010). However, for the purposes of this dissertation we focused on a more conventional simple structure of pro-environmental attitudes which did not consider this potential verticality. This was partly due to only a few studies having examined this vertical structure. Furthermore, the few studies that examined it demonstrated little consensus on whether there was a single or several higher order factors (Milfont & Duckitt, 2010).

Our assessment of how personality was associated with pro-environmental attitudes and behaviours had several limitations. Firstly, in Chapter 4, it was found that the associations between personality domains and pro-environmental attitudes and behaviours was partly moderated by the model of personality (i.e. Big Five or HEXACO) used within a study. This was understandable, as although the Big Five and HEXACO contain similarly named domains (aside from Honesty-Humility), the content similarity of these domains varies (Lee et al., 2015). However, the pattern of moderation was not aligned with the different levels of content similarity found between similarly named domains. For example, both Openness, which is similar in content between models, and Agreeableness, which is different in content between models, were moderated by personality model. Furthermore, the moderation was not consistent within a domain. For example, Openness' association with pro-environmental behaviours was moderated by personality model, but its association with pro-environmental attitudes was not. Although these differences were potentially important ones, few studies had examined how the HEXACO was associated with pro-environmental attitudes and behaviours, with only five being identified in Chapter 4. This limited the ability

to understand why these differences existed or if these differences were robust. In Chapter 5 and 7 we focused on the Big Five model of personality. Although this provided a greater background of research to build on, it came with the limitation of focusing on only one personality model. Another limitation was the lack of studies that had examined how the Big Five's and HEXAO's facets were associated with pro-environmental attitudes and behaviours. The lack of studies in this area, and the inconsistency of facets examined within the few studies that did exist, made it difficult to conduct a meaningful meta-analysis on these associations.

Lastly, there were two limitations that impacted all empirical chapters within this dissertation. The first general limitation was the reliance on self-report measures, particularly in regard to pro-environmental behaviours. This limitation also applied to most of the studies contained within the meta-analysis in Chapter 4, as most studies in environmental and conservation psychology had relied on self-reports of pro-environmental behaviours (Steg & Vlek, 2009). While the use of self-reports has had several advantages (e.g. low cost, ease to use, and flexibility) it also has had its disadvantages (e.g. prone to misreporting or social desirability biases, and the subjective nature of questions; Kormos & Gifford, 2014). There is an underlying assumption that these self-report measures of pro-environmental behaviours reflect actual pro-environmental behaviours. However, it had been debated whether this is true (e.g. R. Gifford, 2014; Hamilton, 1985; Lange, Steinke, & Dewitte, 2018; Warriner, McDougall, & Claxton, 1984). A recent meta-analysis found a large association (r = .46) between self-reported and actual objective pro-environmental behaviours (Kormos & Gifford, 2014). Although this was substantial, Kormos and Gifford argued that it was functionally small, with 79% of the variance in self-report measures being unexplained by actual objective measures of pro-environmental behaviours. This limitation not only applied to our studies

here, but also to the wider literature in environmental and conservation psychology which has currently focused primarily on self-reported measures of pro-environmental behaviours.

There are several potential avenues for measuring pro-environmental behaviours that move away from self-reports as discussed by Lange and Dewitte (2019). One potential avenue of measurement is the use of field observations. Lange and Dewitte break down field observations into three groups. First, there are informant or other-reports. Other-reports are very similar to self-reports, in that they ask a question or series of questions about an individual's pro-environmental behaviours. However, unlike self-reports the respondent is not answering these questions about themself but about another person that they are close to. These respondents can be trained and/or multiple used to get a more objective measure of pro-environmental behaviours. Second, is the use of trained observers, who are often the researchers themselves, or research assistants. Unlike other-reports, trained observers are not closely related to the individual whose behaviour is being assessed. These trained observers can measure pro-environmental behaviours in several ways from simply observing individuals' travel behaviours, to examining how individuals perform in a contrived situation. Lastly, is the use of devices to measure pro-environmental behaviours, such as odometers, or electricity meters. Collectively these field observations can provide a more objective measure of individuals' pro-environmental behaviours, as they are less likely to be influenced by biases (e.g. recall, social-desirability, etc.). However, these field observations do have their downsides.

Lange and Dewitte (2019) outlined several downsides: increased costs (financial and time), lack of control in naturalistic settings, inability to reliably track all participants contributing data points, and difficulty collecting other data from individuals (e.g. personality). There are also other issues of field observations not mentioned by them. First, some pro-environmental behaviours might be difficult or even impossible to measure by

other people. For example, one's voting habits can only be known (ethically) if reported by the individual being assessed. Second, the variety of behaviours collected by trained observers or devices is limited, without extensive budgets. In contrast, self-report or other-report measures can collect information on a wide variety of behaviours, in a cheaper and quicker fashion. Last, certain observations made by devices or trained observers might not be possible at an individual level. For example, unless the examined individual lives alone, electricity or waste measurements would have to be taken at a household level.

Another potential avenue of measurement suggested by Lange and Dewitte (2019) is the use of laboratory observations. Unlike field observations, measuring pro-environmental behaviours in this manner allows researchers to have a greater degree of freedom over the situation. While there are several such measures, there are only a few measures that have been psychometrically evaluated and standardised (Lange & Dewitte, 2019). Lange and Dewitte note three such measures. These being the FISH simulation (J. Gifford & Gifford, 2000; R. Gifford & Wells, 1991), the Pro-Environmental Behaviour Task (Lange et al., 2018), and the Greater Good Game (Klein & Hilbig, 2018; Klein et al., 2017). While these measures provide interesting lab-based measures that are psychometrically sound, they do have their downsides. For example, Lange and Dewitte state that some have argued that these measures lack ecological validity due to their artificial nature. Furthermore, as with field observations, these measures are limited in the variety of pro-environmental behaviours one can measure, whether that be due to cost, time, or what the measures actually assess. Thus, while there are other avenues of measuring pro-environmental behaviours, they are not without their flaws, and self-reports should not be completely abandoned in favour of these other measures. However, inversely self-reports should not be the only measure of pro-environmental behaviours used by researchers.

The second general limitation was how we treated pro-environmental attitudes and behaviours. Apart from pro-environmental attitudes in Chapter 3 and pro-environmental behaviours in Chapter 2, we combined several measures of pro-environmental attitudes and behaviours into a single score. It might be the case that personality and political preferences are associated differentially with specific clusters of pro-environmental attitudes and behaviours. For example, it might be the case that Extraversion would be strongly associated with pro-environmental behaviours that are active and involve social engagement (e.g. community gardens and joining environmental protests) but would be weakly associated with non-active solitary pro-environmental behaviours (e.g. recycling and reducing travelling overseas). This might account for the high heterogeneity amongst personality's associations with pro-environmental attitudes and behaviours found in Chapter 4. However, in our studies we were interested in how personality and political preferences were associated with pro-environmental attitudes and behaviours *per say*, rather than individual pro-environmental attitudes and behaviours measures (Mõttus, 2016). As a result, we combined measures of pro-environmental attitudes and behaviours in our studies, but there might be some utility in separating these into clusters of pro-environmental attitudes and behaviours.

8.3 Future Directions

Despite these limitations, this dissertation contributed to the wider literature, with several avenues for future research. The first of these avenues could be the measurement of pro-environmental attitudes and behaviours. In Chapter 2 and 3, several pro-environmental attitudes measures' test-retest reliability, internal consistency, and predictive validity for pro-environmental behaviours were assessed. Although this provided us, and researchers, a pool of psychometrically sound measures to use, it did not clarify nor select a single measure or set of measures to be the gold-standard with which to measure pro-environmental attitudes. It might be the case that there is never a single gold-standard measure of pro-environmental

attitudes and behaviours. This would not be unique in psychology as even well researched concepts such as the Big Five have several measures to assess it (e.g. BFI-2 and NEO). However, the lack of consistency in measuring pro-environmental attitudes and behaviours is clearly a problem (Markle, 2013; Stern, 1992). The wide variety of measures used to assess pro-environmental attitudes and behaviours could be seen in the review of the literature conducted in Chapter 4. Thus, if a gold-standard cannot be found, future research needs to at least refine and reduce the variety of measures used to assess pro-environmental attitudes and behaviours.

Another consideration for future studies should be the use of other avenues for measuring pro-environmental behaviours. Lange and Dewitte (2019) outlined several avenues for examining pro-environmental behaviours, including field observations and laboratory-based measures. Due to the predominant focus within the literature, and this dissertation, on self-report measures of pro-environmental behaviours, there should be a greater focus on actual objective measures of pro-environmental behaviours in future studies. Although the use of self-reports provides an easy avenue of exploration, its limited practical association with actual objective behaviours is problematic. Thus, if researchers wish for their work to have a practical application in addressing humanity's impact on the natural environment, a greater focus on actual objective pro-environmental behaviours would be required. Ultimately, research should assess pro-environmental behaviours in several different ways to most holistically understand pro-environmental behaviours.

Another avenue for future research could be further examining how personality could be associated with pro-environmental attitudes and behaviours. The work within this dissertation, in particular the meta-analysis in Chapter 4, provided a foundation for research examining how personality could be associated with pro-environmental attitudes and behaviours. As mentioned in section 8.2, it might be the case that personality's associations

with pro-environmental attitudes and behaviours varies depending on the types of pro-environmental attitudes and behaviours examined. For example, within pro-environmental attitudes, are some personality traits more associated with the emotive aspects of pro-environmental attitudes, and other personality traits more associated with the cognitive aspects of these attitudes. This future research would also entail examining whether pro-environmental attitudes and behaviours cluster in reliable patterns.

There were other avenues of research for examining how personality could be associated with pro-environmental attitudes and behaviours that future research could take. Firstly, Chapter 4 made it clear that although there was research into how the HEXACO could be associated with pro-environmental attitudes and behaviours, it was limited in comparison to the amount of research done with the Big Five. More research on how the HEXACO could be associated with pro-environmental attitudes and behaviours should be conducted for two reasons. Firstly, our meta-analysis revealed that the domain of Honesty-Humility was one of the strongest associates of pro-environmental attitudes and behaviours. This domain is unique to the HEXACO and given its strong association with pro-environmental attitudes and behaviours greater research is needed in understanding and utilising this domain to understand and potentially promote pro-environmental attitudes and behaviours. Secondly, our meta-analysis also revealed that the HEXACO's domains were at times differently associated with pro-environmental attitudes and behaviours when compared to their Big Five counterparts. Thus, there were several reasons to further examine how the HEXACO could be associated with pro-environmental attitudes and behaviours.

Expanding on this, examining personality at a narrower level had so far received little attention in the wider literature. As mentioned in Chapter 5, facets could contain a substantial amount of unique information about how people differ in personality above and beyond the domains under which they are subsumed (e.g. Elleman, Condon et al., 2020; Elleman,

McDouglad et al., 2020; Mõttus, 2016; Mõttus & Rozgonjuk, 2019; Paunonen & Ashton, 2001; Vainik et al., 2019). We found in Chapter 5 that examining facets provided a greater understanding of how personality was associated with pro-environmental attitudes and behaviours. This, however, provided no incremental ability to predict pro-environmental attitudes and behaviours, compared to domain-level associations, from personality traits. However, research in these facet-level associations is currently in its infancy. Greater research is needed to examine whether facet-level associations do indeed provide no incremental predictive ability over domain-level associations, or if this was not found due to a lack of power. Furthermore, research is needed to understand what value studying personality at an even narrower level, for example nuances could provide (McCrae, 2015; Mõttus, 2016; Mõttus et al., 2019; Mõttus, Kandler, Bleidorn, Riemann, & McCrae, 2017).

Another avenue for future research could be examining how the knowledge of what types of people were likely to care or act pro-environmentally could be practically used. The research conducted in Chapter 6 and 7 suggested that swapping the term global warming with climate change no longer provided an effective intervention for increasing Conservative's pro-environmental attitudes. However, the work contained in Part 2 and 3 of this dissertation suggested other ways that personality and political preferences could be used to frame effective interventions. Framing messages in ways that consider individual differences had been found to be beneficial in creating effective interventions (Feinberg & Willer, 2015). However, research is needed to assess the proposals we suggested in Part 2 and 3.

For example, one potential way the work in this dissertation could be used is to inform environmental campaigns. As we found in Part 2 and 3 of this dissertation those individuals who are low in Openness, Agreeableness, and Conscientiousness and who are politically Conservative are the least likely to hold pro-environmental attitudes and act pro-environmentally. This suggests that campaigns that target people through compassionate and

moral messaging are unlikely to be effective, as these individuals are unlikely to be swayed by such messages. Instead campaigns should reframe their messages to focus on the personal benefits, the ease of actions, and Conservative morals such as loyalty, and purity. For example, traditionally a campaign wishing to reduce water and energy use from showering might state that if you reduce your shower by X amount you would reduce your carbon emissions by Y, which would help reduce climate change and help save the environment. Or it might focus on how other countries or people lack access to clean water so as to encourage people to not waste water. However, campaigns might be more effective if they focused on how reducing water is simple, easy, and personally beneficial. For example, reducing your shower by just 30 seconds would cut your electricity and water bills by Y, saving you a total of Z each year.

One could test the effectiveness of doing so by screening participants based on their personality and political preferences, and have their water usage, via devices, recorded for a week prior to the intervention. Participants could then be randomly assigned to the traditional water saving campaign or the "reframed" campaign. Participants could receive feedback framed either in terms of reduced carbon emissions or reduced costs over a period of time. During this period of time participants could report their water usage and have their water usage recorded via devices. One would expect that individuals low in Openness, Agreeableness, and Conscientiousness, and who are politically Conservative would reduce their shower lengths only in the "reframed" campaign and not the traditional one. However, it is equally important to assess that those high in Openness, Agreeableness, and Conscientiousness, and who are politically Liberal are not inversely impacted, and one would hope that these individuals would reduce their shower lengths in both conditions.

One might question though if this is overestimating the impact that individual differences could have, and ignoring the impact other factors have, on individual's pro-

environmental behaviours. We agree that individual differences are not the only factor that influence an individual's pro-environmental behaviours, nor might it even be the strongest influence for any one individual. Our meta-analysis in Chapter 4 demonstrated that Big Five personality traits could be used to predict pro-environmental attitudes and behaviours moderately to strongly. However, there was a high degree of heterogeneity in effect sizes for personality traits' associations with pro-environmental attitudes and behaviours. Furthermore, there was a large amount of variation in pro-environmental attitudes and behaviours not shared with personality traits. Thus, we recognise that while individual differences were strongly associated with pro-environmental attitudes and behaviours, there are other variables to consider. For example, regarding the installation of solar panels, no matter how high one is in the individual differences associated with pro-environmental behaviours, without the necessary funds, one will not be able to perform this behaviour.

One might suggest that it would be more useful to instead then focus interventions on social barriers, rather than individual differences. However, we disagree. This is because social barriers, tend to be focused on specific situations, and thus, become less applicable on a wider scale. Thus, if one wants to create interventions that can be broadly applied across societies to create pro-environmental behaviour change on a larger scale, perhaps focusing on individual differences might have more utility than social factors. This targeting of interventions on a large scale is particularly important, because even small changes when aggregated on a large scale can have large environmental impacts. For example, a recent study examining social factors found that giving real-time feedback on shower usage resulted in a 22% reduction in energy and water usage, which when extrapolated to a year results in one person saving 215 kWh of energy, 3,500 litres of water, and 47 kg of carbon emissions (Tiefenbeck et al., 2018). If focusing on individual differences was only 10% as effective as the social factors found by Tiefenbeck and colleagues, and only worked on 0.1% of the

population of the world, that would still result in a saving of 167.7 million kWh, 2.7 billion litres of water, and 36.6 million kg of carbon emissions a year.

Lastly, while this dissertation focused on how individual differences were associated with, and could be used to improve, pro-environmental attitudes and behaviours, there were other important factors that should be considered. For example, social factors such as norms (e.g. St. John et al., 2010) and goal setting (Osbaldiston & Schott, 2012), developmental factors such as early childhood experiences with nature (e.g. Wells & Lekies, 2006), and even other individual differences such as time perspective (Milfont, Wilson, & Diniz, 2012) had been shown to be associated with pro-environmental attitudes and behaviours. Thus, if the goal of researchers is to create a holistic understanding of what promotes and sustains pro-environmental attitudes and behaviours, future research should recognise the interdisciplinary nature of this topic and incorporate a wider range of variables.

8.4 Conclusion

In conclusion, this dissertation examined what types of people do (not) care or act pro-environmentally and contributed to the wider literature in several ways. In Part 1 of this dissertation two measures were created to assess pro-environmental attitudes and behaviours. The psychometric properties of these new measures and existing pro-environmental attitudes measures were assessed. In Part 2, personality's associations with pro-environmental attitudes and behaviours was examined. Openness and Honesty-Humility had the strongest associations with pro-environmental attitudes and behaviours. Agreeableness, Conscientiousness, and Extraversion were also associated with pro-environmental attitudes and behaviours but to a lesser extent. Lastly, Neuroticism was not associated with pro-environmental attitudes and behaviours. Collectively these personality traits accurately predicted pro-environmental attitudes and behaviours in holdout datasets. It was found that examining personality at a facet-level provided a greater understanding of how personality

was associated with pro-environmental attitudes and behaviours. However, this did not translate into a greater ability to predict pro-environmental attitudes and behaviours, when compared to domains. Lastly, in Part 3 a potential mechanism for increasing pro-environmental beliefs via an interaction between question wording and political preferences was examined. Although this interactive effect was not replicated, it was found that Conservatives were less likely to believe in environmental phenomena than Liberals. Furthermore, it was found that Conservatives, to some extent, hold weaker pro-environmental attitudes and behaviours than Liberals. Although there were limitations to this work, this dissertation provided a valuable insight and contribution into how the individual differences of personality and political preferences were associated and might be used to promote pro-environmental attitudes and behaviours.

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Appendices

Appendix A.1: Original Pro-Environmental Attitudes Items

1. Climate change is not as big of a problem as people make it out to be
2. Education institutions should focus on teaching climate change as fact
3. Denying climate change is an outdated idea considering modern day knowledge
4. Climate change is a natural thing and nothing to worry about
5. It is our responsibility to minimise climate change damage, regardless of who caused it
6. As stewards of the land it is our responsibility to care for the environment
7. It is not possible that we have done so much damage to the environment as to cause climate change
8. It is not my responsibility to combat climate change
9. I care greatly about my natural environment
10. I do not think the environment has an innate right to exist
11. I prefer modern architecture to nature
12. I take great pride in my local environment's condition
13. I care if my actions negatively impact the environment
14. There should be a stronger focus on renewable energies
15. I think scientists are wrong about the severity of climate change
16. Fossil fuels are more reliable than renewables, and are needed in the long term
17. There is strong evidence of human induced climate change
18. Strict regulation of human encroachment into natural areas is needed
19. When constructing new infrastructure, the ecological impact must be a top priority
20. We do not need to limit human population growth
21. The construction of new infrastructure doesn't have a huge impact on the environment
22. I think about how my actions will impact the environment in the long term
23. Climate change is not a problem as it won't affect me
24. We should protect and preserve the environment for future generations
25. Climate change is a problem for future generations to solve
26. I am willing to sacrifice parts of my lifestyle to combat climate change
27. Corporations have the right to exploit natural resources for maximum profit
28. The more someone has the better off they are
29. Mass consumerism negatively impacts the environment
30. Humans are separate to nature
31. We could not survive without our natural environment
32. Humans are superior to other animals
33. We do not have the right to do anything we want to the environment
34. A healthy environment produces sustainable resources for human life
35. With modern technology, the environment does not provide any health benefits for us anymore

36. A healthy environment is good for mental health
37. The environment is just there to provide us with resources
38. We should not go out of our way to preserve nature, it should adapt to us
39. The earth should be preserved in its current state
40. Biodiversity is something that should be protected
41. Governments should not put restrictions on people in order to preserve the environment
42. Sometimes pro-environmental people are very aggressive and in-your-face about it
43. The environment makes me feel refreshed and happy
44. I feel helpless to prevent climate change
45. I feel unconnected and distanced from nature
46. Nature is terrifying
47. Certain aspects of nature make me feel a sense of awe
48. I do not feel anything towards nature
49. I don’t feel like nature demands the respect it should
50. I appreciate the complexity and biodiversity of nature
51. I like participating in outdoor activities
52. I like how nature can support such an abundant array of life
53. I find nature aesthetically pleasing to all the senses
54. I find nature is harsh and inconvenient
55. I dislike insects/bugs
56. Planned landscapes and mono-cultures are ugly
57. Dangerous animals should be controlled
58. I dislike seeing polluted environments

Appendix A.2: Original Pro-Environmental Behaviours Items

1. I recycle
2. Support green politicians and policies
3. Drive a fuel-efficient car
4. Take public transport or walk instead of using a car
5. I try and eat less meat
6. I support hunting
7. I eat organic/locally/sustainable produced food
8. I buy environmentally friendly products
9. I invest money in environmental research or renewable energies
10. I grow my own vegetables
11. I participate in community gardens
12. I protest against un-environmental policies/construction
13. I volunteer for environmental agencies
14. When buying a car my highest priority is environmental impact
15. I replant or protect non-invasive wildlife
16. I use energy/water saving devices
17. I donate to environmental organisations
18. I pick up rubbish when I see it
19. I support fracking and oil expansion

Appendix A.3: Four-Factor Pro-Environmental Attitudes Model

Factor 1

1. It is our responsibility to minimise climate change damage, regardless of who caused it (cross loaded with factor 2)
2. As stewards of the land it is our responsibility to care for the environment
3. It is not my responsibility to combat climate change (reverse scored; cross loaded with factor 2)
4. I care greatly about my natural environment
5. I care if my actions negatively impact the environment
6. There is strong evidence of human induced climate change (cross loaded with factor 2 and 4)
7. Strict regulation of human encroachment into natural areas is needed
8. When constructing new infrastructure, the ecological impact must be a top priority
9. I think about how my actions will impact the environment in the long term (cross loaded with factor 3)
10. We should protect and preserve the environment for future generations
11. I am willing to sacrifice parts of my lifestyle to combat climate change
12. Humans are separate to nature (reverse scored)
13. A healthy environment produces sustainable resources for human life
14. A healthy environment is good for mental health
15. Biodiversity is something that should be protected
16. The environment makes me feel refreshed and happy
17. Certain aspects of nature make me feel a sense of awe
18. I do not feel anything towards nature (reverse scored; cross loaded with factor 3)
19. I appreciate the complexity and biodiversity of nature
20. I like how nature can support such an abundant array of life
21. I find nature aesthetically pleasing to all the senses
22. I find nature is harsh and inconvenient (reverse scored)
23. I dislike seeing polluted environments

Factor 2

1. Climate change is not as big of a problem as people make it out to be
2. Education institutions should focus on teaching climate change as fact (reverse scored; cross loaded with factor 3)
3. Climate change is a natural thing and nothing to worry about
4. It is our responsibility to minimise climate change damage, regardless of who caused it (reverse scored; cross loaded with factor 1)
5. It is not possible that we have done so much damage to the environment as to cause climate change
6. It is not my responsibility to combat climate change (cross loaded with factor 1)
7. There should be a stronger focus on renewable energies (reverse scored; cross loaded with factor 4)
8. I think scientists are wrong about the severity of climate change
9. Fossil fuels are more reliable than renewables, and are needed in the long term
10. There is strong evidence of human induced climate change (reverse scored; cross loaded with factor 1 and 4)
11. Climate change is not a problem as it won't affect me
12. Corporations have the right to exploit natural resources for maximum profit

13. Humans are superior to other animals
14. With modern technology, the environment does not provide any health benefits for us anymore (cross loaded with factor 3)
15. The environment is just there to provide us with resources
16. We should not go out of our way to preserve nature, it should adapt to us (cross loaded with factor 4)

Factor 3

1. Education institutions should focus on teaching climate change as fact (cross loaded with factor 2)
2. I think about how my actions will impact the environment in the long term (cross loaded with factor 1)
3. With modern technology, the environment does not provide any health benefits for us anymore (cross loaded with factor 2)
4. I feel unconnected and distanced from nature
5. I do not feel anything towards nature (cross loaded with factor 1)

Factor 4

1. Denying climate change is an outdated idea considering modern day knowledge
2. There should be a stronger focus on renewable energies (cross loaded with factor 2)
3. There is strong evidence of human induced climate change (cross loaded with factor 1 and 2)
4. We should not go out of our way to preserve nature, it should adapt to us (cross loaded with factor 2)

Table A.3.1. Factor Analysis Output of Four-Factor Pro-Environmental Attitudes

Item	Factor 1	Factor 2	Factor 3	Factor 4	Communalities (h2)	Uniqueness (u2)	Complexity (Hoffman's index)
ES50	0.81	0.09	-0.04	0.04	0.58	0.42	1.0
ES43	0.77	0.18	-0.10	-0.06	0.47	0.53	1.2
ES9	0.76	-0.03	0.01	-0.11	0.62	0.38	1.0
ES24	0.73	-0.13	0.03	0.07	0.67	0.33	1.1
ES58	0.70	-0.03	-0.15	0.14	0.55	0.45	1.2
ES52	0.69	0.16	-0.09	-0.04	0.37	0.63	1.2
ES6	0.66	-0.10	0.15	0.08	0.58	0.42	1.2
ES40	0.65	-0.07	-0.01	0.13	0.51	0.49	1.1
ES36	0.60	-0.11	0.05	0.07	0.46	0.54	1.1
ES34	0.59	0.00	-0.15	0.31	0.47	0.53	1.7
ES48	-0.57	0.13	0.44	0.15	0.64	0.36	2.2
ES53	0.57	0.05	-0.07	-0.29	0.37	0.63	1.6
ES22	0.56	-0.11	0.36	-0.30	0.58	0.42	2.4
ES47	0.54	-0.05	0.11	-0.09	0.34	0.66	1.2
ES13	0.53	-0.23	0.16	-0.23	0.52	0.48	2.0
ES19	0.52	-0.26	0.11	0.18	0.58	0.42	1.9
ES26	0.51	-0.27	0.26	0.07	0.62	0.38	2.1
ES18	0.50	-0.10	0.08	0.10	0.36	0.64	1.2
ES5	0.47	-0.33	0.24	0.12	0.64	0.36	2.5
ES54	-0.44	0.06	0.21	0.25	0.33	0.67	2.1
ES30	-0.37	0.21	0.26	-0.12	0.35	0.65	2.7
ES4	0.05	0.86	-0.05	-0.01	0.70	0.30	1.0
ES15	0.03	0.81	-0.15	-0.04	0.68	0.32	1.1
ES1	-0.04	0.77	-0.02	-0.16	0.71	0.29	1.1
ES27	0.01	0.75	0.07	0.19	0.56	0.44	1.2
ES23	-0.09	0.73	0.19	-0.02	0.64	0.36	1.2
ES7	-0.04	0.71	0.22	-0.17	0.61	0.39	1.3
ES16	0.10	0.69	-0.03	-0.13	0.45	0.55	1.1
ES37	-0.06	0.64	0.01	0.31	0.49	0.51	1.5
ES38	-0.16	0.59	0.06	0.38	0.56	0.44	1.9
ES2	0.26	-0.55	0.35	0.10	0.74	0.26	2.3
ES35	-0.13	0.53	0.52	-0.02	0.59	0.41	2.1
ES32	-0.04	0.50	-0.03	0.26	0.30	0.70	1.5
ES17	0.35	-0.46	0.19	0.37	0.81	0.19	3.2
ES8	-0.35	0.45	-0.08	-0.06	0.54	0.46	2.0
ES45	-0.31	0.12	0.40	0.18	0.35	0.65	2.5
ES14	0.28	-0.34	0.07	0.40	0.54	0.46	2.9
ES3	0.28	-0.31	0.21	0.34	0.51	0.49	3.6

Appendix A.4: Three-Factor Pro-Environmental Attitudes Model

Factor 1

1. Education institutions should focus on teaching climate change as fact (cross loaded with factor 2 and 3)
2. Denying climate change is an outdated idea considering modern day knowledge (cross loaded with factor 3)
3. It is our responsibility to minimise climate change damage, regardless of who caused it
4. As stewards of the land it is our responsibility to care for the environment
5. It is not my responsibility to combat climate change (reverse scored; cross loaded with factor 2)
6. I care greatly about my natural environment
7. I care if my actions negatively impact the environment
8. There should be a stronger focus on renewable energies (cross loaded with factor 3)
9. There is strong evidence of human induced climate change (cross loaded with factor 2 and 3)
10. Strict regulation of human encroachment into natural areas is needed
11. When constructing new infrastructure, the ecological impact must be a top priority
12. I think about how my actions will impact the environment in the long term
13. We should protect and preserve the environment for future generations
14. I am willing to sacrifice parts of my lifestyle to combat climate change
15. Humans are separate to nature (reverse scored)
16. A healthy environment produces sustainable resources for human life
17. A healthy environment is good for mental health
18. Biodiversity is something that should be protected
19. The environment makes me feel refreshed and happy
20. Certain aspects of nature make me feel a sense of awe
21. I do not feel anything towards nature (reverse scored; cross loaded with factor 3)
22. I appreciate the complexity and biodiversity of nature
23. I like how nature can support such an abundant array of life
24. I find nature aesthetically pleasing to all the senses
25. I find nature is harsh and inconvenient (reverse scored; cross loaded with factor 3)
26. I dislike seeing polluted environments

Factor 2

1. Climate change is not as big of a problem as people make it out to be
2. Education institutions should focus on teaching climate change as fact (reverse scored; cross loaded with factor 1 and 3)
3. Climate change is a natural thing and nothing to worry about
4. It is not possible that we have done so much damage to the environment as to cause climate change
5. It is not my responsibility to combat climate change (cross loaded with factor 1)
6. I do not think the environment has an innate right to exist
7. I think scientists are wrong about the severity of climate change
8. Fossil fuels are more reliable than renewables, and are needed in the long term
9. There is strong evidence of human induced climate change (reverse scored; cross loaded with factor 1 and 3)
10. The construction of new infrastructure doesn’t have a huge impact on the environment
11. Climate change is not a problem as it won’t affect me

12. Climate change is a problem for future generations to solve
13. Corporations have the right to exploit natural resources for maximum profit
14. Humans are superior to other animals
15. With modern technology, the environment does not provide any health benefits for us anymore (cross loaded with factor 3)
16. The environment is just there to provide us with resources
17. We should not go out of our way to preserve nature, it should adapt to us
18. Governments should not put restrictions on people in order to preserve the environment

Factor 3

1. Education institutions should focus on teaching climate change as fact (cross loaded with factor 1 and 2)
2. Denying climate change is an outdated idea considering modern day knowledge (cross loaded with factor 1)
3. There should be a stronger focus on renewable energies (cross loaded with factor 1)
4. There is strong evidence of human induced climate change (cross loaded with factor 1 and 2)
5. With modern technology, the environment does not provide any health benefits for us anymore (cross loaded with factor 2)
6. I feel unconnected and distanced from nature
7. I do not feel anything towards nature (cross loaded with factor 1)
8. I find nature is harsh and inconvenient (cross loaded with factor 1)

Table A.4.1. Factor Analysis Output of Three-Factor Pro-Environmental Attitudes

Item	Factor 1	Factor 2	Factor 3	Communalities (h2)	Uniqueness (u2)	Complexity (Hoffman's index)
ES50	0.81	0.09	-0.07	0.57	0.43	1.0
ES43	0.77	0.17	-0.18	0.48	0.52	1.2
ES9	0.77	-0.02	-0.10	0.61	0.39	1.0
ES24	0.75	-0.09	0.05	0.68	0.32	1.0
ES6	0.71	-0.02	0.17	0.58	0.42	1.1
ES58	0.70	-0.03	-0.04	0.51	0.49	1.0
ES52	0.67	0.12	-0.18	0.38	0.62	1.2
ES40	0.67	-0.05	0.06	0.50	0.50	1.0
ES36	0.64	-0.04	0.09	0.46	0.54	1.0
ES34	0.59	0.00	0.08	0.36	0.64	1.0
ES22	0.58	-0.03	0.07	0.37	0.63	1.0
ES26	0.57	-0.18	0.26	0.60	0.40	1.6
ES53	0.56	0.04	-0.26	0.33	0.67	1.4
ES47	0.56	-0.03	-0.01	0.33	0.67	1.0
ES19	0.55	-0.21	0.21	0.58	0.42	1.6
ES13	0.55	-0.16	-0.01	0.44	0.56	1.2
ES5	0.54	-0.22	0.30	0.63	0.37	1.9
ES18	0.53	-0.07	0.12	0.36	0.64	1.1
ES48	-0.48	0.27	0.47	0.61	0.39	2.6
ES54	-0.38	0.14	0.36	0.32	0.68	2.3
ES30	-0.34	0.26	0.11	0.29	0.71	2.1
ES4	0.03	0.79	-0.18	0.68	0.32	1.1
ES23	-0.04	0.78	0.07	0.64	0.36	1.0
ES27	0.05	0.77	0.10	0.53	0.47	1.0
ES1	-0.05	0.73	-0.21	0.70	0.30	1.2
ES37	0.01	0.71	0.19	0.47	0.53	1.1
ES15	-0.01	0.71	-0.26	0.66	0.34	1.3
ES7	-0.03	0.70	-0.05	0.54	0.46	1.0
ES35	-0.04	0.65	0.33	0.47	0.53	1.5
ES16	0.09	0.65	-0.21	0.45	0.55	1.3
ES38	-0.10	0.64	0.25	0.49	0.51	1.4
ES10	-0.22	0.53	0.18	0.47	0.53	1.6
ES32	-0.01	0.51	0.11	0.26	0.74	1.1
ES41	-0.14	0.51	0.05	0.36	0.64	1.2
ES21	-0.16	0.44	0.15	0.30	0.70	1.5
ES8	-0.36	0.42	-0.13	0.55	0.45	2.2
ES25	-0.08	0.41	0.20	0.22	0.78	1.5
ES17	0.44	-0.32	0.47	0.80	0.20	2.7
ES45	-0.23	0.24	0.45	0.32	0.68	2.1
ES3	0.36	-0.18	0.44	0.50	0.50	2.3
ES2	0.35	-0.38	0.43	0.71	0.29	2.9
ES14	0.35	-0.24	0.38	0.49	0.51	2.7

Appendix A.5: Two-Factor Pro-Environmental Attitudes Model

Factor 1

1. Climate change is not as big of a problem as people make it out to be
2. Education institutions should focus on teaching climate change as fact (reverse scored)
3. Denying climate change is an outdated idea considering modern day knowledge (reverse scored)
4. Climate change is a natural thing and nothing to worry about
5. It is our responsibility to minimise climate change damage, regardless of who caused it (reverse scored)
6. As stewards of the land it is our responsibility to care for the environment (reverse scored; cross loaded with factor 2)
7. It is not possible that we have done so much damage to the environment as to cause climate change
8. It is not my responsibility to combat climate change
9. I do not think the environment has an innate right to exist (cross loaded with factor 2)
10. There should be a stronger focus on renewable energies (reverse scored)
11. I think scientists are wrong about the severity of climate change
12. Fossil fuels are more reliable than renewables, and are needed in the long term
13. There is strong evidence of human induced climate change (reverse scored)
14. When constructing new infrastructure, the ecological impact must be a top priority (reverse scored; cross loaded with factor 2)
15. Climate change is not a problem as it won't affect me
16. I am willing to sacrifice parts of my lifestyle to combat climate change (reverse scored)
17. Corporations have the right to exploit natural resources for maximum profit
18. Mass consumerism negatively impacts the environment (reverse scored)
19. Humans are superior to other animals
20. We do not have the right to do anything we want to the environment (reverse scored)
21. The environment is just there to provide us with resources
22. We should not go out of our way to preserve nature, it should adapt to us
23. Governments should not put restrictions on people in order to preserve the environment

Factor 2

1. As stewards of the land it is our responsibility to care for the environment (cross loaded with factor 1)
2. I care greatly about my natural environment
3. I do not think the environment has an innate right to exist (reverse scored; cross loaded with factor 1)
4. I care if my actions negatively impact the environment
5. Strict regulation of human encroachment into natural areas is needed
6. When constructing new infrastructure, the ecological impact must be a top priority (cross loaded with factor 1)
7. I think about how my actions will impact the environment in the long term
8. We should protect and preserve the environment for future generations
9. Humans are separate to nature (reverse scored)
10. A healthy environment produces sustainable resources for human life
11. A healthy environment is good for mental health

12. Biodiversity is something that should be protected
13. The environment makes me feel refreshed and happy
14. I feel unconnected and distanced from nature (reverse scored)
15. Certain aspects of nature make me feel a sense of awe
16. I do not feel anything towards nature (reverse scored)
17. I appreciate the complexity and biodiversity of nature
18. I like how nature can support such an abundant array of life
19. I find nature aesthetically pleasing to all the senses
20. I find nature is harsh and inconvenient (reverse scored)
21. I dislike seeing polluted environments

Table A.5.1. Factor Analysis Output for Two-Factor Pro-Environmental Attitudes

Item	Factor 1	Factor 2	Communalities (h2)	Uniqueness (u2)	Complexity (Hoffman's index)
ES15	0.88	0.12	0.66	0.34	1.0
ES1	0.85	0.05	0.68	0.32	1.0
ES4	0.84	0.08	0.64	0.36	1.0
ES17	-0.80	0.07	0.71	0.29	1.0
ES2	-0.80	0.03	0.67	0.33	1.0
ES16	0.76	0.19	0.45	0.55	1.1
ES7	0.68	-0.04	0.49	0.51	1.0
ES14	-0.65	0.04	0.45	0.55	1.0
ES23	0.64	-0.14	0.54	0.46	1.1
ES3	-0.64	0.01	0.41	0.59	1.0
ES5	-0.59	0.26	0.59	0.41	1.4
ES27	0.58	-0.09	0.42	0.58	1.1
ES8	0.57	-0.24	0.54	0.46	1.4
ES26	-0.52	0.31	0.55	0.45	1.6
ES19	-0.50	0.33	0.55	0.45	1.7
ES29	-0.48	0.07	0.28	0.72	1.0
ES37	0.45	-0.18	0.33	0.67	1.3
ES41	0.45	-0.18	0.33	0.67	1.3
ES32	0.37	-0.12	0.21	0.79	1.2
ES10	0.37	-0.34	0.40	0.60	2.0
ES38	0.37	-0.31	0.36	0.64	1.9
ES33	-0.32	0.27	0.27	0.73	1.9
ES43	0.15	0.76	0.47	0.53	1.1
ES48	-0.06	-0.73	0.48	0.52	1.0
ES9	-0.09	0.72	0.61	0.39	1.0
ES50	-0.04	0.72	0.55	0.45	1.0
ES52	0.12	0.68	0.38	0.62	1.1
ES53	0.16	0.66	0.34	0.66	1.1
ES58	-0.15	0.61	0.51	0.49	1.1
ES24	-0.30	0.61	0.67	0.33	1.4
ES54	-0.12	-0.58	0.27	0.73	1.1
ES40	-0.25	0.52	0.48	0.52	1.4
ES45	-0.12	-0.50	0.19	0.81	1.1
ES6	-0.32	0.48	0.52	0.48	1.7
ES36	-0.25	0.48	0.44	0.56	1.5
ES13	-0.26	0.48	0.45	0.55	1.5
ES47	-0.15	0.47	0.33	0.67	1.2
ES22	-0.20	0.46	0.36	0.64	1.4
ES34	-0.21	0.43	0.33	0.67	1.4
ES30	0.21	-0.37	0.27	0.73	1.6
ES18	-0.29	0.36	0.34	0.66	1.9

Appendix A.6: One-Factor Pro-Environmental Attitudes Model

1. Climate change is not as big of a problem as people make it out to be (reverse scored)
2. Education institutions should focus on teaching climate change as fact
3. Denying climate change is an outdated idea considering modern day knowledge
4. Climate change is a natural thing and nothing to worry about (reverse scored)
5. It is our responsibility to minimise climate change damage, regardless of who caused it
6. As stewards of the land it is our responsibility to care for the environment
7. It is not possible that we have done so much damage to the environment as to cause climate change (reverse scored)
8. It is not my responsibility to combat climate change (reverse scored)
9. I care greatly about my natural environment
10. I do not think the environment has an innate right to exist (reverse scored)
11. I care if my actions negatively impact the environment
12. There should be a stronger focus on renewable energies
13. I think scientists are wrong about the severity of climate change (reverse scored)
14. Fossil fuels are more reliable than renewables, and are needed in the long term (reverse scored)
15. There is strong evidence of human induced climate change
16. Strict regulation of human encroachment into natural areas is needed
17. When constructing new infrastructure, the ecological impact must be a top priority
18. I think about how my actions will impact the environment in the long term
19. Climate change is not a problem as it won't affect me (reverse scored)
20. We should protect and preserve the environment for future generations
21. I am willing to sacrifice parts of my lifestyle to combat climate change
22. Corporations have the right to exploit natural resources for maximum profit (reverse scored)
23. Mass consumerism negatively impacts the environment
24. Humans are separate to nature (reverse scored)
25. Humans are superior to other animals (reverse scored)
26. We do not have the right to do anything we want to the environment
27. A healthy environment produces sustainable resources for human life
28. A healthy environment is good for mental health
29. The environment is just there to provide us with resources (reverse scored)
30. We should not go out of our way to preserve nature, it should adapt to us (reverse scored)
31. Biodiversity is something that should be protected
32. Governments should not put restrictions on people in order to preserve the environment (reverse scored)
33. The environment makes me feel refreshed and happy
34. Certain aspects of nature make me feel a sense of awe
35. I do not feel anything towards nature (reverse scored)
36. I appreciate the complexity and biodiversity of nature
37. I like how nature can support such an abundant array of life
38. I find nature aesthetically pleasing to all the senses
39. I find nature is harsh and inconvenient (reverse scored)
40. I dislike seeing polluted environments

Table A.6.1. Factor Analysis Output of One-Factor Pro-Environmental Attitudes

Item	Factor 1	Communalities (h2)	Uniqueness (u2)	Complexity (Hoffman's index)
ES17	0.80	0.64	0.36	1.0
ES24	0.80	0.63	0.37	1.0
ES5	0.76	0.58	0.42	1.0
ES2	0.76	0.58	0.42	1.0
ES26	0.74	0.55	0.45	1.0
ES19	0.74	0.55	0.45	1.0
ES1	-0.74	0.54	0.46	1.0
ES8	-0.73	0.53	0.47	1.0
ES6	0.71	0.51	0.49	1.0
ES23	-0.71	0.50	0.50	1.0
ES4	-0.70	0.50	0.50	1.0
ES15	-0.70	0.49	0.51	1.0
ES9	0.70	0.49	0.51	1.0
ES40	0.67	0.45	0.55	1.0
ES58	0.66	0.44	0.56	1.0
ES13	0.65	0.42	0.58	1.0
ES7	-0.65	0.42	0.58	1.0
ES50	0.65	0.42	0.58	1.0
ES36	0.65	0.42	0.58	1.0
ES10	-0.63	0.40	0.60	1.0
ES14	0.63	0.39	0.61	1.0
ES27	-0.62	0.38	0.62	1.0
ES38	-0.60	0.36	0.64	1.0
ES3	0.60	0.35	0.65	1.0
ES22	0.58	0.34	0.66	1.0
ES18	0.58	0.33	0.67	1.0
ES37	-0.57	0.32	0.68	1.0
ES41	-0.57	0.32	0.68	1.0
ES34	0.56	0.31	0.69	1.0
ES48	-0.56	0.31	0.69	1.0
ES47	0.54	0.30	0.70	1.0
ES16	-0.54	0.29	0.71	1.0
ES33	0.52	0.28	0.72	1.0
ES29	0.51	0.26	0.74	1.0
ES43	0.51	0.26	0.74	1.0
ES30	-0.51	0.26	0.74	1.0
ES52	0.47	0.22	0.78	1.0
ES32	-0.45	0.20	0.80	1.0
ES53	0.41	0.17	0.83	1.0
ES54	-0.38	0.14	0.86	1.0

Appendix A.7: Two-Factor Pro-Environmental Behaviours Model

Factor 1

1. Drive a fuel-efficient car (cross loaded with factor 2)
2. I eat organic/locally/sustainable produced food
3. I buy environmentally friendly products
4. I invest money in environmental research or renewable energies
5. I grow my own vegetables
6. I participate in community gardens
7. I protest against un-environmental policies/construction
8. I volunteer for environmental agencies
9. When buying a car my highest priority is environmental impact (cross loaded with factor 2)
10. I replant or protect non-invasive wildlife
11. I use energy/water saving devices
12. I donate to environmental organisations
13. I pick up rubbish when I see it
14. I support fracking and oil expansion (cross loaded with factor 2)

Factor 2

1. I recycle
2. Support green politicians and policies
3. Drive a fuel-efficient car (cross loaded with factor 1)
4. I try and eat less meat
5. When buying a car my highest priority is environmental impact (cross loaded with factor 1)
6. I support fracking and oil expansion (reverse scored; cross loaded with factor 1)

Table A.7.1. Factor Analysis Output of Two-Factor Pro-Environmental Behaviours

Item	Factor 1	Factor 2	Communalities (h2)	Uniqueness (u2)	Complexity (Hoffman's index)
EB13	0.82	-0.03	0.65	0.35	1.0
EB9	0.75	-0.05	0.54	0.46	1.0
EB11	0.69	-0.18	0.43	0.57	1.1
EB10	0.66	0.04	0.46	0.54	1.0
EB17	0.64	0.09	0.45	0.55	1.0
EB15	0.56	0.11	0.37	0.63	1.1
EB7	0.52	0.12	0.33	0.67	1.1
EB16	0.49	0.14	0.31	0.69	1.2
EB8	0.48	0.28	0.41	0.59	1.6
EB3	0.41	0.37	0.41	0.59	2.0
EB12	0.38	0.25	0.27	0.73	1.7
EB18	0.37	0.29	0.30	0.70	1.9
EB2	0.05	0.78	0.64	0.36	1.0
EB19	0.38	-0.58	0.33	0.67	1.7
EB14	0.34	0.56	0.56	0.44	1.7
EB5	0.09	0.40	0.20	0.80	1.1
EB1	0.15	0.32	0.16	0.84	1.4

Appendix A.8: One-Factor Pro-Environmental Behaviours Model

1. I recycle
2. Support green politicians and policies
3. Drive a fuel-efficient car
4. I try and eat less meat
5. I eat organic/locally/sustainable produced food
6. I buy environmentally friendly products
7. I invest money in environmental research or renewable energies
8. I grow my own vegetables
9. I participate in community gardens
10. I protest against un-environmental policies/construction
11. I volunteer for environmental agencies
12. When buying a car my highest priority is environmental impact
13. I replant or protect non-invasive wildlife
14. I use energy/water saving devices
15. I donate to environmental organisations
16. I pick up rubbish when I see it

Table A.8.1. Factor Analysis Output of One-Factor Pro-Environmental Behaviours

Item	Factor 1	Communalities (h2)	Uniqueness (u2)	Complexity (Hoffman's index)
EB13	0.75	0.56	0.44	1.0
EB9	0.68	0.46	0.54	1.0
EB14	0.67	0.45	0.55	1.0
EB17	0.66	0.44	0.56	1.0
EB10	0.65	0.42	0.58	1.0
EB8	0.64	0.41	0.59	1.0
EB3	0.62	0.39	0.61	1.0
EB15	0.60	0.36	0.64	1.0
EB7	0.57	0.33	0.67	1.0
EB16	0.56	0.31	0.69	1.0
EB18	0.54	0.29	0.71	1.0
EB11	0.53	0.29	0.71	1.0
EB12	0.52	0.27	0.73	1.0
EB2	0.51	0.26	0.74	1.0
EB1	0.34	0.12	0.88	1.0
EB5	0.34	0.11	0.89	1.0

Appendix A.9: Corrected Three-, Two-, and One-Factor Pro-Environmental Attitudes Models

Three-Factor Model

Factor 1

1. It is our responsibility to minimise climate change damage, regardless of who caused it
2. As stewards of the land it is our responsibility to care for the environment
3. It is not my responsibility to combat climate change (reverse scored; cross loaded with factor 2)
4. I care greatly about my natural environment
5. There is strong evidence of human induced climate change (cross loaded with factor 2 and 3)
6. Strict regulation of human encroachment into natural areas is needed
7. When constructing new infrastructure, the ecological impact must be a top priority
8. I think about how my actions will impact the environment in the long term
9. We should protect and preserve the environment for future generations
10. I am willing to sacrifice parts of my lifestyle to combat climate change
11. Humans are separate to nature (reverse scored)
12. A healthy environment produces sustainable resources for human life
13. A healthy environment is good for mental health
14. Biodiversity is something that should be protected
15. The environment makes me feel refreshed and happy
16. Certain aspects of nature make me feel a sense of awe
17. I do not feel anything towards nature (reverse scored; cross loaded with factor 3)
18. I appreciate the complexity and biodiversity of nature
19. I like how nature can support such an abundant array of life
20. I find nature aesthetically pleasing to all the senses
21. I find nature is harsh and inconvenient (reverse scored)
22. I dislike seeing polluted environments

Factor 2

1. Climate change is not as big of a problem as people make it out to be
2. Education institutions should focus on teaching climate change as fact (reverse scored; cross loaded with factor 3)
3. Climate change is a natural thing and nothing to worry about
4. It is not possible that we have done so much damage to the environment as to cause climate change
5. It is not my responsibility to combat climate change (cross loaded with factor 1)
6. I do not think the environment has an innate right to exist
7. I think scientists are wrong about the severity of climate change
8. Fossil fuels are more reliable than renewables, and are needed in the long term
9. There is strong evidence of human induced climate change (reverse scored; cross loaded with factor 1 and 3)
10. Climate change is not a problem as it won't affect me
11. Corporations have the right to exploit natural resources for maximum profit
12. Humans are superior to other animals
13. The environment is just there to provide us with resources

14. We should not go out of our way to preserve nature, it should adapt to us (cross loaded with factor 3)
15. Governments should not put restrictions on people in order to preserve the environment

Factor 3

1. Education institutions should focus on teaching climate change as fact (cross loaded with factor 2)
2. Denying climate change is an outdated idea considering modern day knowledge
3. There should be a stronger focus on renewable energies
4. There is strong evidence of human induced climate change (cross loaded with factor 1 and 2)
5. We should not go out of our way to preserve nature, it should adapt to us (cross loaded with factor 2)
6. I do not feel anything towards nature (cross loaded with factor 1)

Table A.9.1. Factor Analysis Output of Three-Factor Pro-Environmental Attitudes Corrected Measure

Item	Factor 1	Factor 2	Factor 3	Communalities (h2)	Uniqueness (u2)	Complexity (Hoffman's index)
ES50	0.81	0.08	0.00	0.58	0.42	1.0
ES43	0.78	0.17	-0.09	0.47	0.53	1.1
ES9	0.76	-0.05	-0.07	0.61	0.39	1.0
ES24	0.73	-0.14	0.06	0.70	0.30	1.1
ES52	0.70	0.14	-0.11	0.39	0.61	1.1
ES58	0.69	-0.01	0.06	0.51	0.49	1.0
ES40	0.65	-0.04	0.12	0.51	0.49	1.1
ES6	0.64	-0.07	0.20	0.57	0.43	1.2
ES48	-0.61	0.19	0.40	0.59	0.41	2.0
ES36	0.60	-0.09	0.10	0.47	0.53	1.1
ES34	0.59	0.05	0.20	0.39	0.61	1.2
ES53	0.56	0.01	-0.24	0.32	0.68	1.4
ES47	0.53	-0.07	-0.02	0.33	0.67	1.0
ES22	0.50	-0.12	0.04	0.35	0.65	1.1
ES18	0.49	-0.08	0.17	0.36	0.64	1.3
ES19	0.49	-0.22	0.27	0.58	0.42	2.0
ES26	0.48	-0.23	0.28	0.59	0.41	2.1
ES5	0.45	-0.28	0.29	0.62	0.38	2.5
ES54	-0.45	0.09	0.29	0.29	0.71	1.8
ES30	-0.39	0.20	0.03	0.28	0.72	1.5
ES4	0.06	0.82	-0.12	0.69	0.31	1.1
ES27	0.02	0.78	0.16	0.55	0.45	1.1
ES15	0.05	0.78	-0.18	0.67	0.33	1.1
ES1	-0.03	0.74	-0.20	0.70	0.30	1.2
ES23	-0.09	0.73	0.04	0.61	0.39	1.0
ES37	-0.04	0.71	0.26	0.50	0.50	1.3
ES38	-0.15	0.66	0.34	0.55	0.45	1.6
ES7	-0.06	0.65	-0.09	0.52	0.48	1.1
ES16	0.11	0.64	-0.21	0.45	0.55	1.3
ES32	-0.03	0.55	0.20	0.30	0.70	1.3
ES10	-0.28	0.51	0.19	0.48	0.52	1.9
ES2	0.22	-0.49	0.35	0.68	0.32	2.3
ES41	-0.18	0.46	0.01	0.34	0.66	1.3
ES8	-0.33	0.44	-0.14	0.55	0.45	2.1
ES17	0.33	-0.37	0.51	0.82	0.18	2.6
ES3	0.26	-0.22	0.47	0.51	0.49	2.0
ES14	0.26	-0.26	0.45	0.53	0.47	2.3

Two-Factor Model

Factor 1

1. Climate change is not as big of a problem as people make it out to be
2. Education institutions should focus on teaching climate change as fact (reverse scored)

3. Denying climate change is an outdated idea considering modern day knowledge (reverse scored)
4. Climate change is a natural thing and nothing to worry about
5. It is our responsibility to minimise climate change damage, regardless of who caused it (reverse scored)
6. It is not possible that we have done so much damage to the environment as to cause climate change
7. It is not my responsibility to combat climate change
8. I do not think the environment has an innate right to exist (cross loaded with factor 2)
9. There should be a stronger focus on renewable energies (reverse scored)
10. I think scientists are wrong about the severity of climate change
11. Fossil fuels are more reliable than renewables, and are needed in the long term
12. There is strong evidence of human induced climate change (reverse scored)
13. When constructing new infrastructure, the ecological impact must be a top priority (reverse scored; cross loaded with factor 2)
14. Climate change is not a problem as it won't affect me
15. I am willing to sacrifice parts of my lifestyle to combat climate change (reverse scored; cross loaded with factor 2)
16. Corporations have the right to exploit natural resources for maximum profit
17. Mass consumerism negatively impacts the environment (reverse scored)
18. Humans are superior to other animals
19. The environment is just there to provide us with resources
20. We should not go out of our way to preserve nature, it should adapt to us
21. Governments should not put restrictions on people in order to preserve the environment

Factor 2

1. As stewards of the land it is our responsibility to care for the environment
2. I care greatly about my natural environment
3. I do not think the environment has an innate right to exist (reverse scored; cross loaded with factor 1)
4. Strict regulation of human encroachment into natural areas is needed
5. When constructing new infrastructure, the ecological impact must be a top priority (cross loaded with factor 1)
6. I think about how my actions will impact the environment in the long term
7. We should protect and preserve the environment for future generations
8. I am willing to sacrifice parts of my lifestyle to combat climate change (cross loaded with factor 1)
9. Humans are separate to nature (reverse scored)
10. A healthy environment produces sustainable resources for human life
11. A healthy environment is good for mental health
12. Biodiversity is something that should be protected
13. The environment makes me feel refreshed and happy
14. Certain aspects of nature make me feel a sense of awe
15. I do not feel anything towards nature (reverse scored)
16. I appreciate the complexity and biodiversity of nature
17. I like how nature can support such an abundant array of life
18. I find nature aesthetically pleasing to all the senses
19. I find nature is harsh and inconvenient (reverse scored)
20. I dislike seeing polluted environments

Table A.9.2. Factor Analysis Output of Two-Factor Pro-Environmental Attitudes Corrected Measure

Item	Factor 1	Factor 2	Communalities (h2)	Uniqueness (u2)	Complexity (Hoffman's index)
ES15	0.88	0.11	0.67	0.33	1.0
ES4	0.86	0.09	0.66	0.34	1.0
ES1	0.86	0.04	0.69	0.31	1.0
ES16	0.77	0.19	0.46	0.54	1.1
ES2	-0.76	0.07	0.66	0.34	1.0
ES17	-0.76	0.12	0.71	0.29	1.1
ES7	0.70	-0.02	0.51	0.49	1.0
ES23	0.67	-0.11	0.55	0.45	1.1
ES14	-0.62	0.07	0.44	0.56	1.0
ES27	0.62	-0.05	0.43	0.57	1.0
ES3	-0.59	0.07	0.40	0.60	1.0
ES8	0.55	-0.26	0.54	0.46	1.4
ES5	-0.54	0.31	0.59	0.41	1.6
ES26	-0.48	0.35	0.55	0.45	1.8
ES37	0.48	-0.15	0.33	0.67	1.2
ES19	-0.47	0.35	0.54	0.46	1.9
ES29	-0.46	0.10	0.28	0.72	1.1
ES41	0.45	-0.17	0.33	0.67	1.3
ES38	0.39	-0.27	0.35	0.65	1.8
ES32	0.38	-0.11	0.21	0.79	1.2
ES10	0.38	-0.33	0.40	0.60	2.0
ES43	0.16	0.77	0.47	0.53	1.1
ES50	0.00	0.76	0.58	0.42	1.0
ES9	-0.07	0.74	0.61	0.39	1.0
ES52	0.15	0.70	0.39	0.61	1.1
ES48	-0.05	-0.70	0.45	0.55	1.0
ES24	-0.25	0.66	0.69	0.31	1.3
ES58	-0.13	0.62	0.50	0.50	1.1
ES53	0.14	0.61	0.29	0.71	1.1
ES40	-0.20	0.56	0.49	0.51	1.3
ES54	-0.09	-0.53	0.23	0.77	1.1
ES6	-0.29	0.52	0.53	0.47	1.6
ES36	-0.22	0.52	0.46	0.54	1.4
ES47	-0.12	0.50	0.34	0.66	1.1
ES34	-0.17	0.47	0.35	0.65	1.3
ES22	-0.19	0.46	0.35	0.65	1.3
ES18	-0.25	0.39	0.34	0.66	1.7
ES30	0.21	-0.37	0.27	0.73	1.6

One-Factor Model

1. Climate change is not as big of a problem as people make it out to be (reverse scored)
2. Education institutions should focus on teaching climate change as fact
3. Denying climate change is an outdated idea considering modern day knowledge

4. Climate change is a natural thing and nothing to worry about (reverse scored)
5. It is our responsibility to minimise climate change damage, regardless of who caused it
6. As stewards of the land it is our responsibility to care for the environment
7. It is not possible that we have done so much damage to the environment as to cause climate change (reverse scored)
8. It is not my responsibility to combat climate change (reverse scored)
9. I care greatly about my natural environment
10. I do not think the environment has an innate right to exist (reverse scored)
11. There should be a stronger focus on renewable energies
12. I think scientists are wrong about the severity of climate change (reverse scored)
13. Fossil fuels are more reliable than renewables, and are needed in the long term (reverse scored)
14. There is strong evidence of human induced climate change
15. Strict regulation of human encroachment into natural areas is needed
16. When constructing new infrastructure, the ecological impact must be a top priority
17. I think about how my actions will impact the environment in the long term
18. Climate change is not a problem as it won't affect me (reverse scored)
19. We should protect and preserve the environment for future generations
20. I am willing to sacrifice parts of my lifestyle to combat climate change
21. Corporations have the right to exploit natural resources for maximum profit (reverse scored)
22. Mass consumerism negatively impacts the environment
23. Humans are separate to nature (reverse scored)
24. Humans are superior to other animals (reverse scored)
25. A healthy environment produces sustainable resources for human life
26. A healthy environment is good for mental health
27. The environment is just there to provide us with resources (reverse scored)
28. We should not go out of our way to preserve nature, it should adapt to us (reverse scored)
29. Biodiversity is something that should be protected
30. Governments should not put restrictions on people in order to preserve the environment (reverse scored)
31. The environment makes me feel refreshed and happy
32. Certain aspects of nature make me feel a sense of awe
33. I do not feel anything towards nature (reverse scored)
34. I appreciate the complexity and biodiversity of nature
35. I like how nature can support such an abundant array of life
36. I find nature aesthetically pleasing to all the senses
37. I find nature is harsh and inconvenient (reverse scored)
38. I dislike seeing polluted environments

Table A.9.3. Factor Analysis Output of One-Factor Pro-Environmental Attitudes Corrected Measure

Item	Factor 1	Communalities (h2)	Uniqueness (u2)	Complexity (Hoffman's index)
ES17	0.81	0.65	0.35	1.0
ES24	0.80	0.64	0.36	1.0
ES5	0.77	0.59	0.41	1.0
ES2	0.76	0.58	0.42	1.0
ES1	-0.75	0.56	0.44	1.0
ES26	0.74	0.55	0.45	1.0
ES19	0.74	0.55	0.45	1.0
ES8	-0.73	0.54	0.46	1.0
ES6	0.71	0.51	0.49	1.0
ES23	-0.71	0.51	0.49	1.0
ES4	-0.71	0.50	0.50	1.0
ES15	-0.70	0.49	0.51	1.0
ES9	0.70	0.49	0.51	1.0
ES40	0.67	0.45	0.55	1.0
ES7	-0.66	0.43	0.57	1.0
ES58	0.65	0.43	0.57	1.0
ES36	0.65	0.43	0.57	1.0
ES50	0.65	0.42	0.58	1.0
ES10	-0.63	0.40	0.60	1.0
ES14	0.63	0.40	0.60	1.0
ES27	-0.61	0.38	0.62	1.0
ES3	0.60	0.36	0.64	1.0
ES38	-0.59	0.35	0.65	1.0
ES18	0.57	0.33	0.67	1.0
ES22	0.57	0.32	0.68	1.0
ES41	-0.57	0.32	0.68	1.0
ES34	0.56	0.32	0.68	1.0
ES37	-0.56	0.32	0.68	1.0
ES48	-0.56	0.31	0.69	1.0
ES47	0.54	0.29	0.71	1.0
ES16	-0.54	0.29	0.71	1.0
ES30	-0.51	0.26	0.74	1.0
ES43	0.51	0.26	0.74	1.0
ES29	0.51	0.26	0.74	1.0
ES52	0.46	0.21	0.79	1.0
ES32	-0.44	0.20	0.80	1.0
ES53	0.40	0.16	0.84	1.0
ES54	-0.38	0.14	0.86	1.0

Full Measure used in Chapter 4, 5, and 7

1. There is strong evidence of human induced climate change
2. We should protect and preserve the environment for future generations
3. Education institutions should focus on teaching global warming as fact
4. It is our responsibility to minimize climate change damage, regardless of who caused it

5. Climate change is not as big of a problem as people make it out to be
6. I am willing to sacrifice parts of my lifestyle to combat climate change
7. When constructing new infrastructure, the ecological impact must be a top priority
8. It is not my responsibility to combat climate change
9. Climate change is a natural thing and nothing to worry about
10. As stewards of the land it is our responsibility to care for the environment
11. I think the scientists are wrong about the severity of climate change
12. Climate change is not a problem as it won't affect me
13. I care greatly about my natural environment
14. It is not possible that we have done so much damage to the environment as to cause climate change
15. Biodiversity is something that should be protected
16. A healthy environment is good for mental health
17. There should be a stronger focus on renewable energies
18. I dislike seeing polluted environments
19. I appreciate the complexity and biodiversity of nature
20. I do not think the environment has an innate right to exist
21. Denying climate change is an outdated idea considering modern day knowledge
22. Corporations have the right to exploit natural resources for maximum profit
23. We should not go out of our way to preserve nature, it should adapt to us
24. Strict regulation of human encroachment into natural areas is needed
25. I think about how my actions will impact the environment in the long term
26. Governments should not put restrictions on people in order to preserve the environment
27. A healthy environment produces sustainable resources for human life
28. The environment is just there to provide us with resources
29. Fossil fuels are more reliable than renewables, and are needed in the long term
30. I do not feel anything towards nature
31. Certain aspects of nature make me feel a sense of awe
32. Mass consumerism negatively impacts the environment
33. Humans are separate to nature
34. The environment makes me feel refreshed and happy
35. I like how nature can support such an abundant array of life
36. Humans are superior to other animals
37. I find nature aesthetically pleasing to all the senses
38. I find nature is harsh and inconvenient

Appendix A.10: Corrected Three-, Two-, and One-Factor Pro-Environmental Behaviours Models

Three-Factor Model

Factor 1

1. Drive a fuel-efficient car (cross loaded with factor 3)
2. I invest money in environmental research or renewable energies
3. I volunteer for environmental agencies
4. When buying a car my highest priority is environmental impact (cross loaded with factor 3)
5. I use energy/water saving devices
6. I donate to environmental organisations

Factor 2

1. I eat organic/locally/sustainable produced food
2. I grow my own vegetables
3. I participate in community gardens
4. I replant or protect non-invasive wildlife
5. I pick up rubbish when I see it

Factor 3

1. I recycle
2. Support green politicians and policies
3. Drive a fuel-efficient car (cross loaded with factor 1)
4. When buying a car my highest priority is environmental impact (cross loaded with factor 1)
5. I support fracking and oil expansion (reverse scored)

Table A.10.1. Factor Analysis Output of Three-Factor Pro-Environmental Behaviours Corrected Measure

Item	Factor 1	Factor 2	Factor 3	Communalities (h2)	Uniqueness (u2)	Complexity (Hoffman's index)
EB17	0.79	-0.06	0.07	0.59	0.41	1.0
EB9	0.74	0.07	-0.03	0.61	0.39	1.0
EB13	0.61	0.30	-0.05	0.66	0.34	1.5
EB16	0.37	0.15	0.15	0.30	0.70	1.7
EB15	-0.10	0.76	0.16	0.58	0.42	1.1
EB11	0.12	0.70	-0.20	0.56	0.44	1.2
EB10	0.13	0.64	0.06	0.56	0.44	1.1
EB18	0.04	0.40	0.28	0.32	0.68	1.8
EB7	0.24	0.33	0.06	0.28	0.72	1.9
EB2	0.03	0.07	0.79	0.68	0.32	1.0
EB19	0.30	0.07	-0.53	0.29	0.71	1.6
EB14	0.44	-0.02	0.52	0.57	0.43	1.9
EB3	0.33	0.15	0.42	0.47	0.53	2.2
EB1	0.06	0.12	0.36	0.19	0.81	1.3

Two-Factor Model

Factor 1

1. Drive a fuel-efficient car (cross loaded with factor 2)
2. I eat organic/locally/sustainable produced food
3. I invest money in environmental research or renewable energies
4. I grow my own vegetables
5. I participate in community gardens
6. I protest against un-environmental policies/construction
7. I volunteer for environmental agencies
8. When buying a car my highest priority is environmental impact (cross loaded with factor 2)
9. I replant or protect non-invasive wildlife
10. I use energy/water saving devices
11. I donate to environmental organisations
12. I pick up rubbish when I see it
13. I support fracking and oil expansion (cross loaded with factor 2)

Factor 2

1. I recycle
2. Support green politicians and policies
3. Drive a fuel-efficient car (cross loaded with factor 1)
4. When buying a car my highest priority is environmental impact (cross loaded with factor 1)
5. I support fracking and oil expansion (reverse scored; cross loaded with factor 1)

Table A.10.2. Factor Analysis Output of Two-Factor Pro-Environmental Behaviours Corrected Measure

Item	Factor 1	Factor 2	Communalities (h2)	Uniqueness (u2)	Complexity (Hoffman's index)
EB13	0.82	-0.05	0.65	0.35	1.0
EB9	0.74	-0.01	0.54	0.46	1.0
EB11	0.70	-0.17	0.44	0.56	1.1
EB10	0.66	0.06	0.47	0.53	1.0
EB17	0.63	0.07	0.44	0.56	1.0
EB15	0.55	0.16	0.39	0.61	1.2
EB7	0.51	0.07	0.29	0.71	1.0
EB16	0.47	0.15	0.30	0.70	1.2
EB3	0.41	0.40	0.44	0.56	2.0
EB18	0.38	0.28	0.29	0.71	1.8
EB12	0.37	0.26	0.27	0.73	1.8
EB2	0.03	0.87	0.78	0.22	1.0
EB19	0.36	-0.54	0.29	0.71	1.8
EB14	0.36	0.50	0.50	0.50	1.8
EB1	0.14	0.34	0.17	0.83	1.3

One-Factor Model

1. I recycle
2. Support green politicians and policies
3. Drive a fuel-efficient car
4. I eat organic/locally/sustainable produced food
5. I invest money in environmental research or renewable energies
6. I grow my own vegetables
7. I participate in community gardens
8. I protest against un-environmental policies/construction
9. I volunteer for environmental agencies
10. When buying a car my highest priority is environmental impact
11. I replant or protect non-invasive wildlife
12. I use energy/water saving devices
13. I donate to environmental organisations
14. I pick up rubbish when I see it

Table A.10.3. Factor Analysis Output of One-Factor Pro-Environmental Behaviours Corrected Measure

Item	Factor 1	Communalities (h2)	Uniqueness (u2)	Complexity (Hoffman's index)
EB13	0.75	0.56	0.44	1.0
EB9	0.69	0.48	0.52	1.0
EB10	0.67	0.45	0.55	1.0
EB17	0.65	0.42	0.58	1.0
EB14	0.63	0.40	0.60	1.0
EB3	0.63	0.40	0.60	1.0
EB15	0.63	0.40	0.60	1.0
EB11	0.56	0.31	0.69	1.0
EB16	0.55	0.30	0.70	1.0
EB7	0.54	0.29	0.71	1.0
EB18	0.53	0.28	0.72	1.0
EB12	0.51	0.26	0.74	1.0
EB2	0.51	0.26	0.74	1.0
EB1	0.35	0.12	0.88	1.0

Full Measure used in Chapter 4, 5, and 7

1. I recycle
2. Support green politicians and policies
3. Take public transport or walk instead of using a car
4. I support hunting
5. I eat organic/locally/sustainable produced food
6. I invest money in environmental research or renewable energies
7. I grow my own vegetables
8. I participate in community gardens
9. I protest against un-environmental policies/construction
10. I volunteer for environmental agencies
11. When buying a car my highest priority is environmental impact

12. I replant or protect non-invasive wildlife
13. I use energy/water saving devices.
14. I donate to environmental organisations
15. I pick up rubbish when I see it
16. I support fracking and oil expansion
17. Drive a fuel-efficient car

Appendix B.1: Forest, Funnel, and *P*-Curve Plots

Figure B1. Funnel Plot of Agreeableness and Pro-Environmental Attitudes

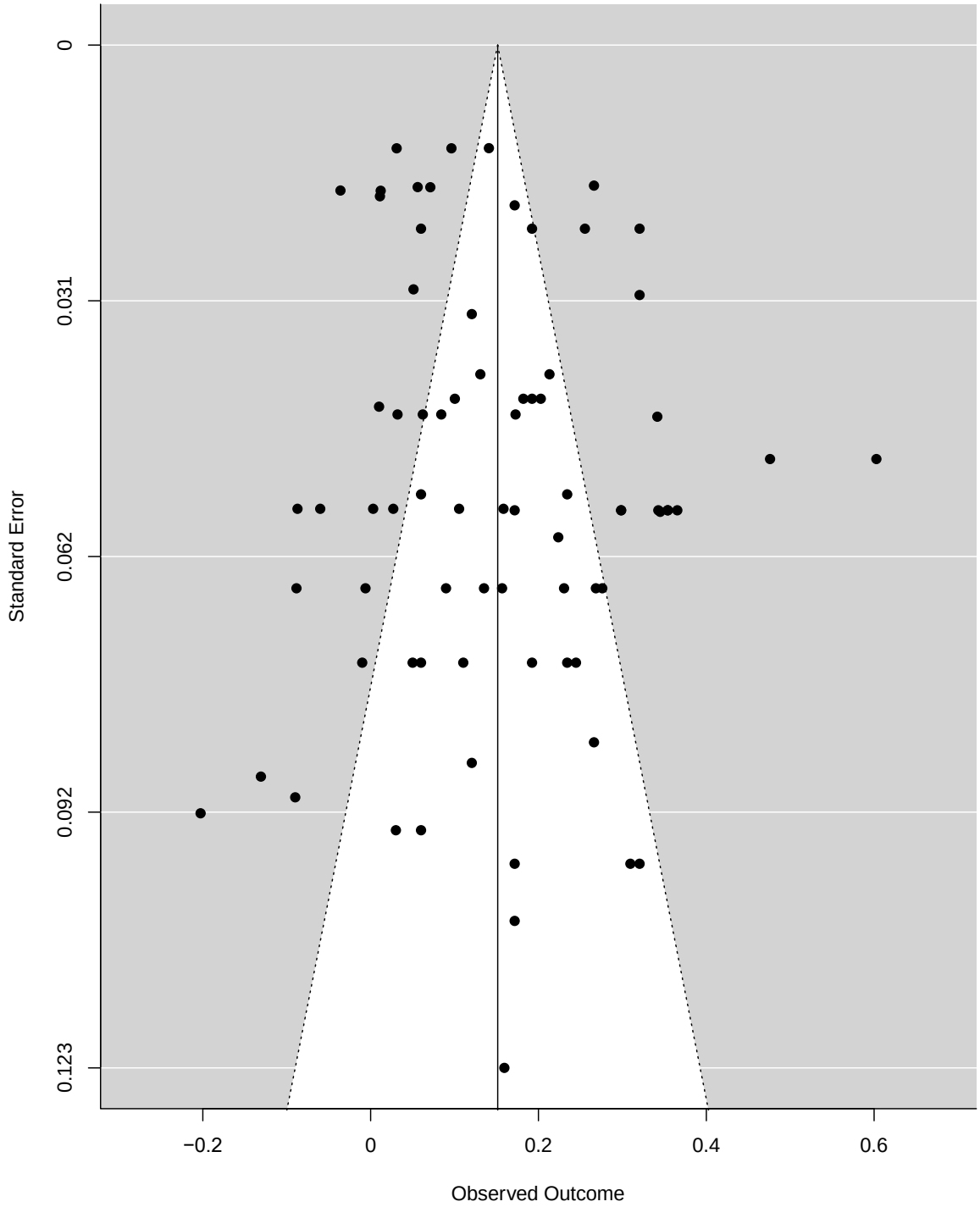
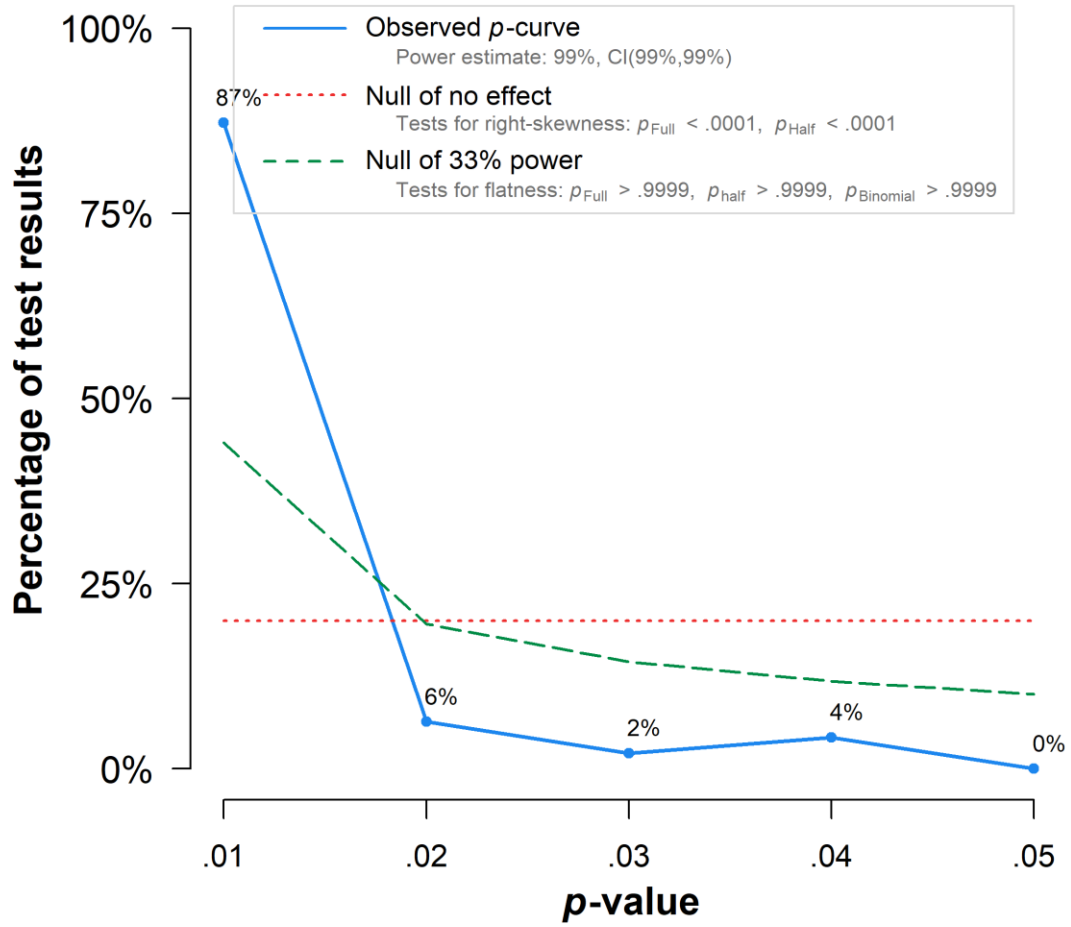


Figure B2. *P*-curve of Agreeableness and Pro-Environmental Attitudes



Note: The observed *p*-curve includes 47 statistically significant ($p < .05$) results, of which 44 are $p < .025$. There were 28 additional results entered but excluded from *p*-curve because they were $p > .05$.

Figure B3. Forest Plot of Agreeableness and Pro-Environmental Attitudes

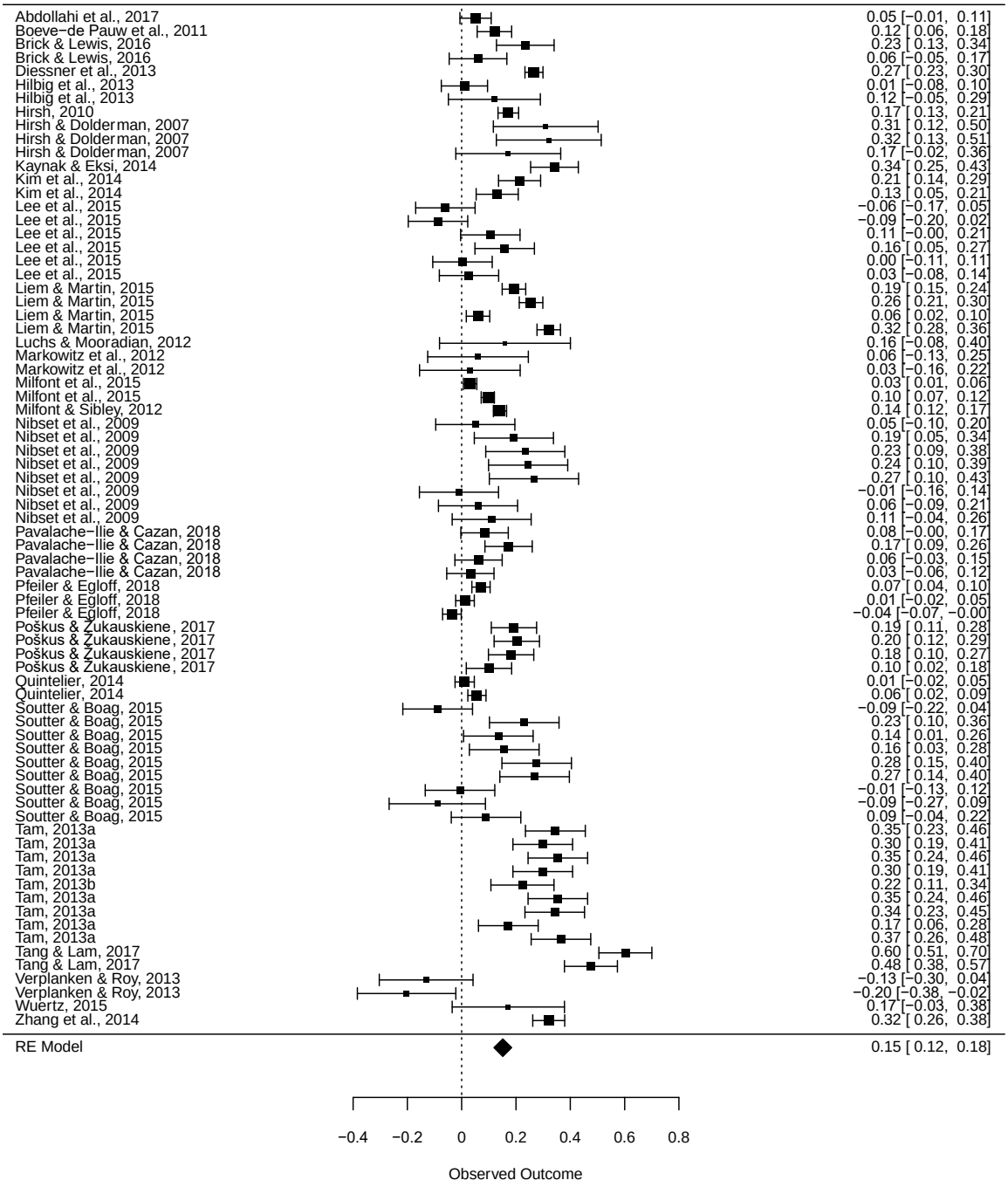


Figure B4. Funnel Plot of Agreeableness and Pro-Environmental Behaviours

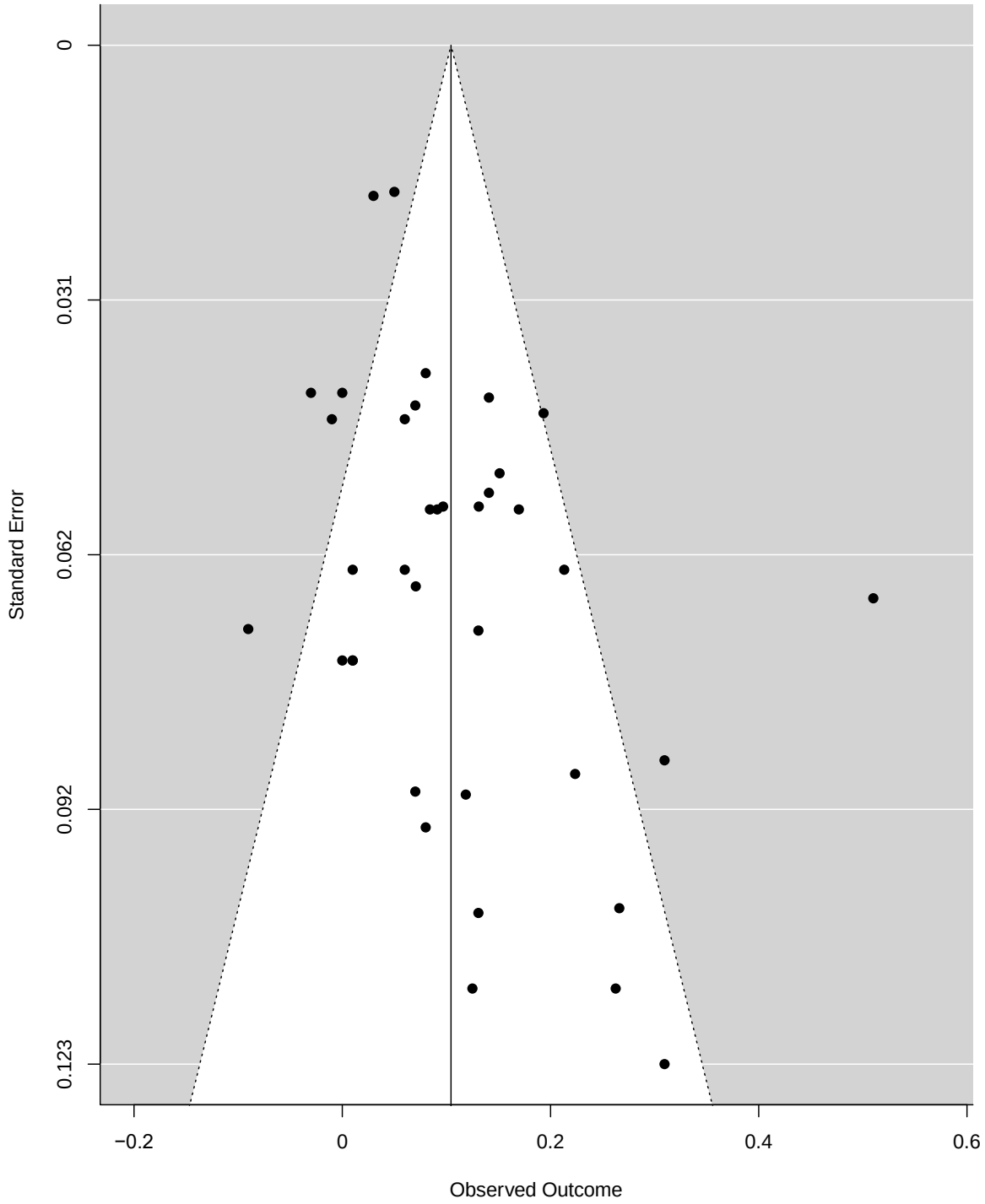
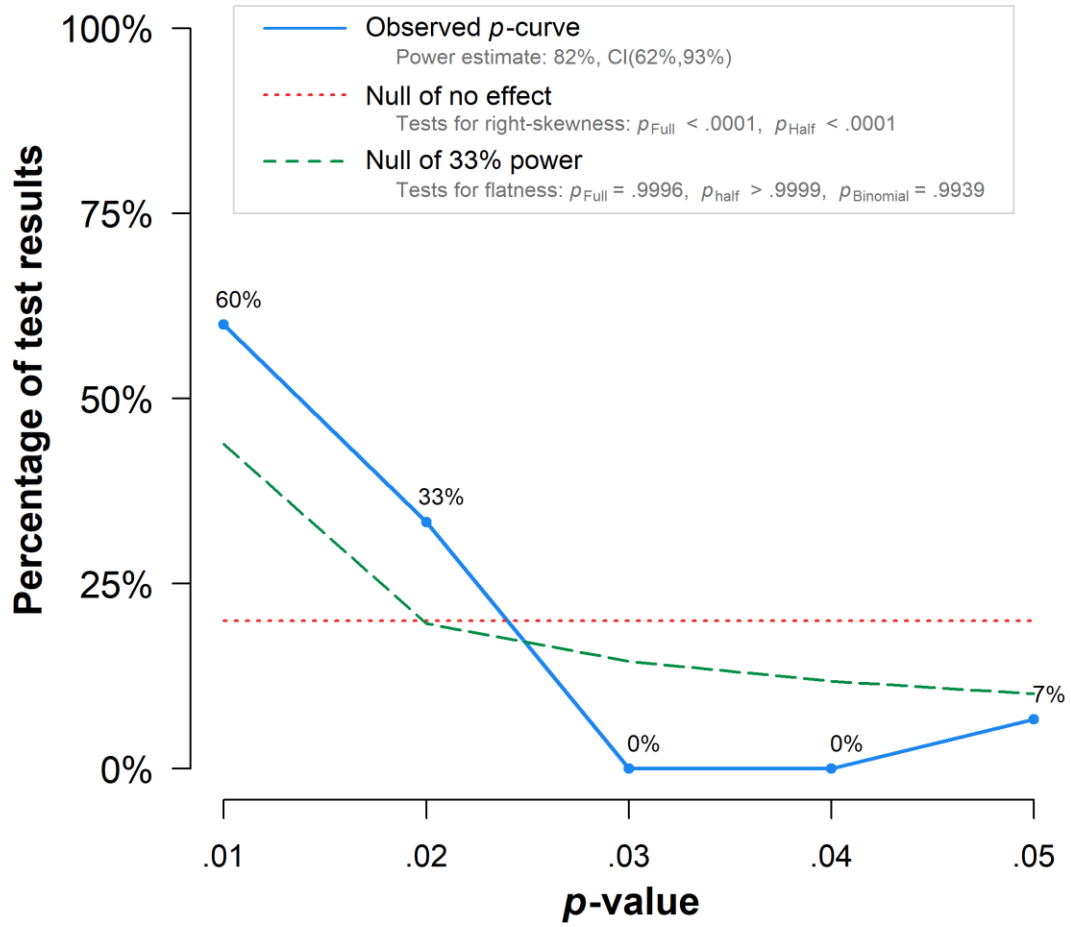


Figure B5. *P*-curve of Agreeableness and Pro-Environmental Behaviours



Note: The observed *p*-curve includes 15 statistically significant ($p < .05$) results, of which 14 are $p < .025$. There were 22 additional results entered but excluded from *p*-curve because they were $p > .05$.

Figure B6. Forest Plot of Agreeableness and Pro-Environmental Behaviours

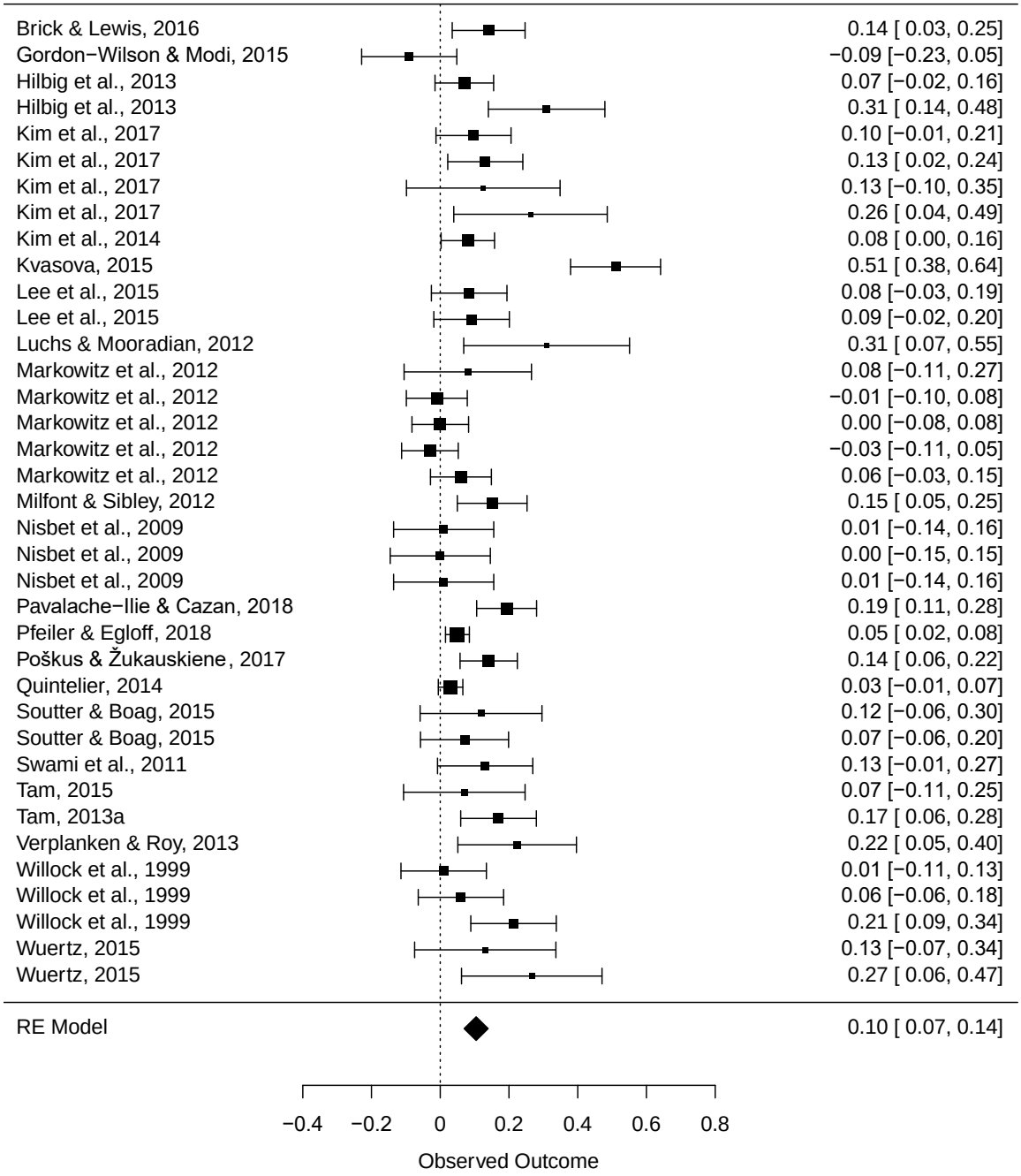


Figure B7. Funnel Plot of Conscientiousness and Pro-Environmental Attitudes

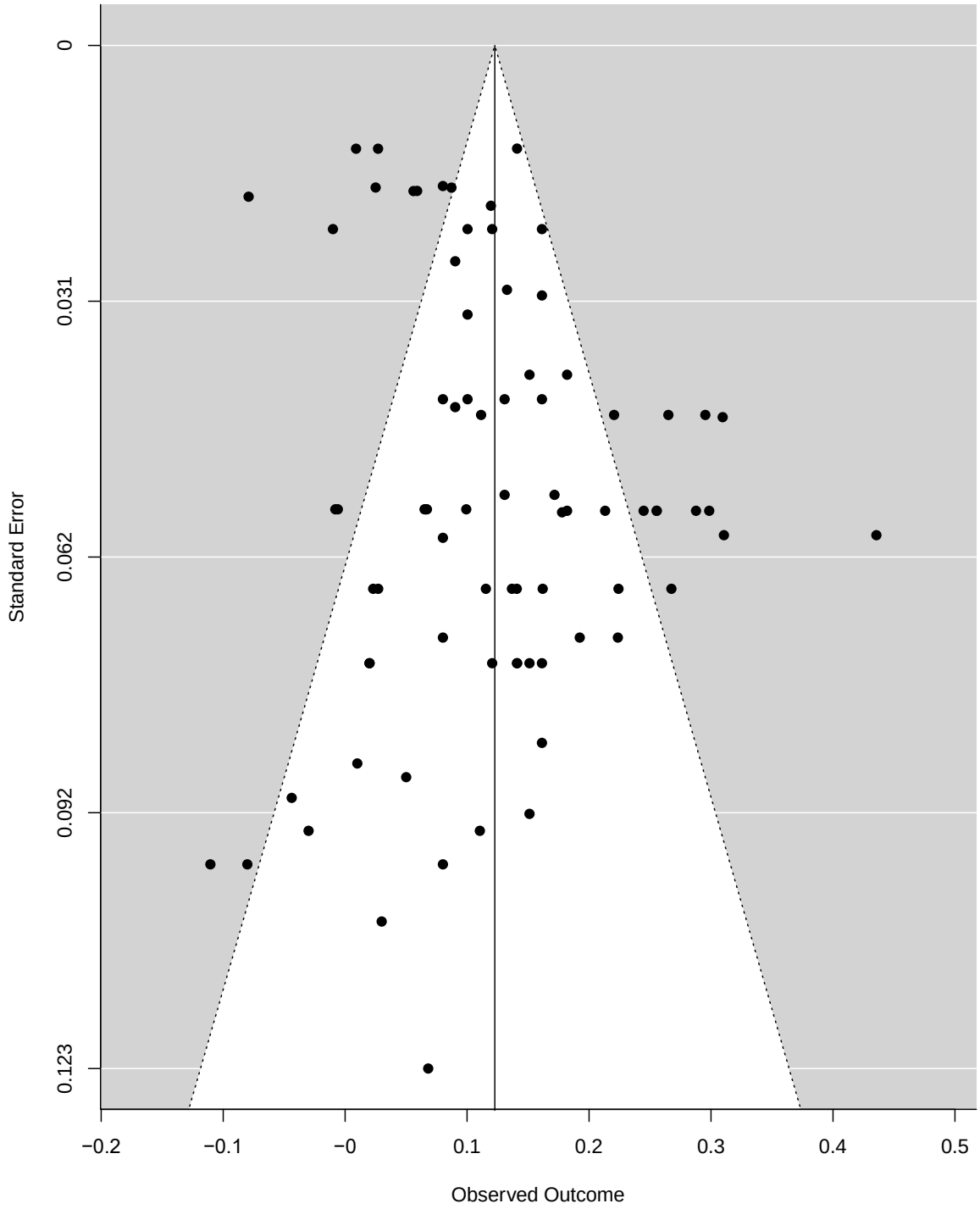
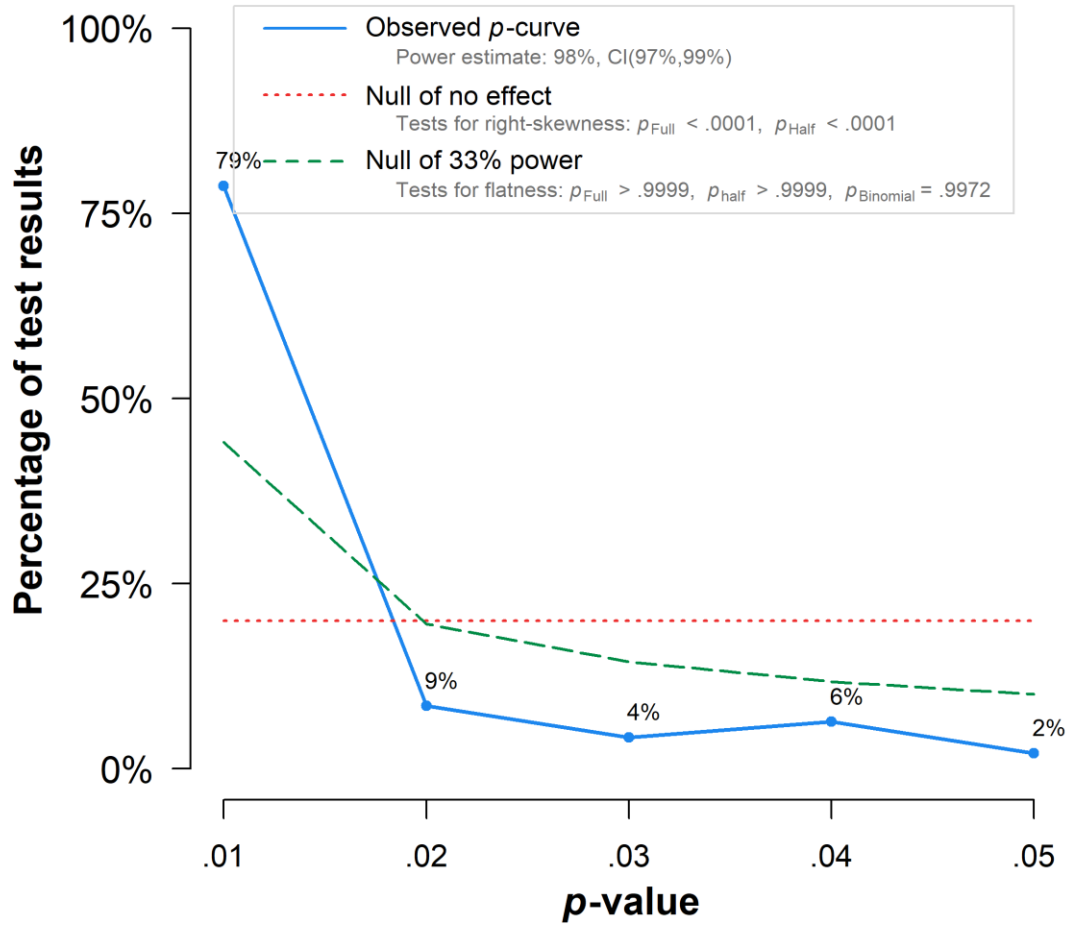


Figure B8. *P*-curve of Conscientiousness and Pro-Environmental Attitudes



Note: The observed *p*-curve includes 47 statistically significant ($p < .05$) results, of which 41 are $p < .025$. There were 32 additional results entered but excluded from *p*-curve because they were $p > .05$.

Figure B9. Forest Plot of Conscientiousness and Pro-Environmental Attitudes

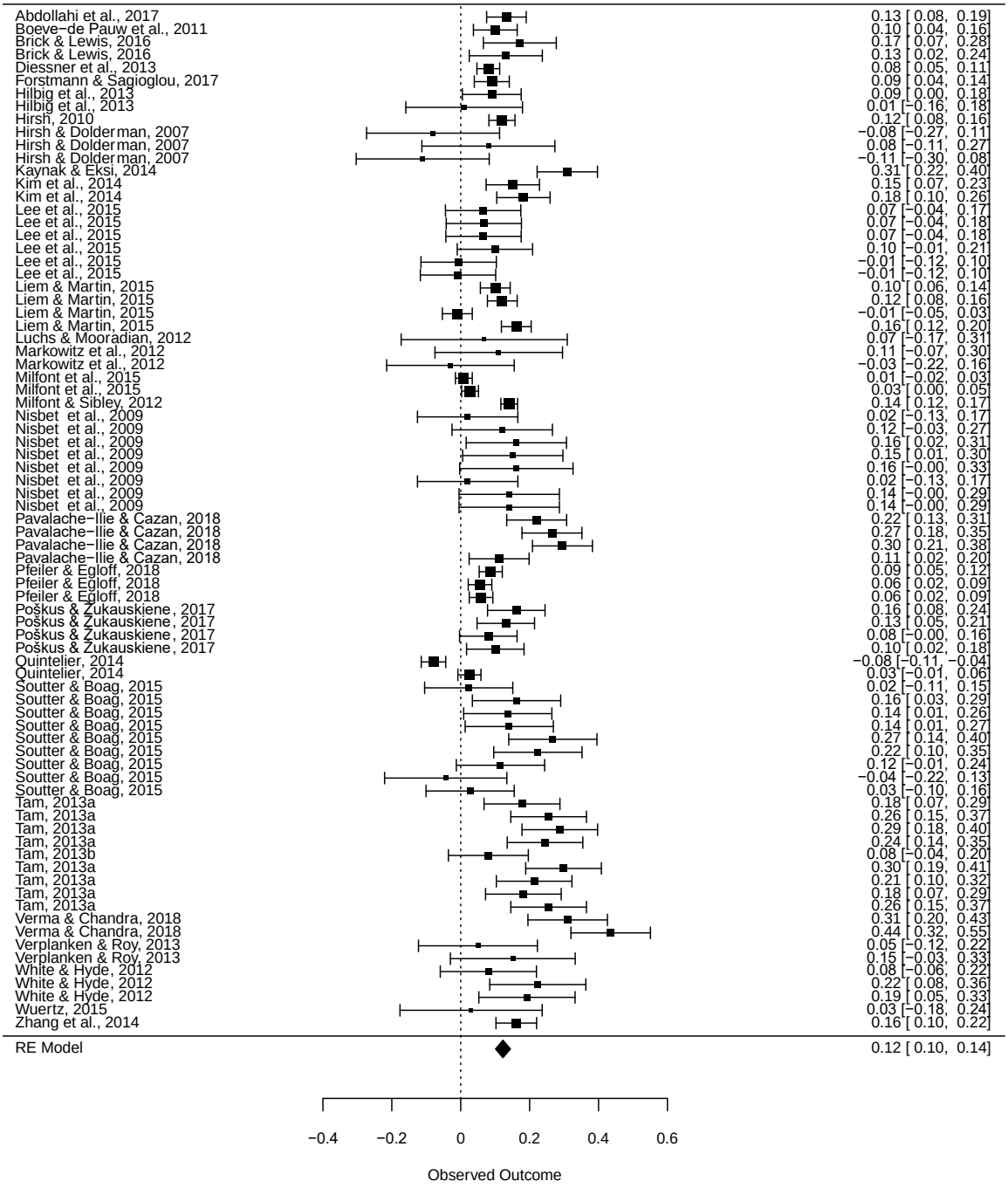


Figure B10. Funnel Plot of Conscientiousness and Pro-Environmental Behaviours

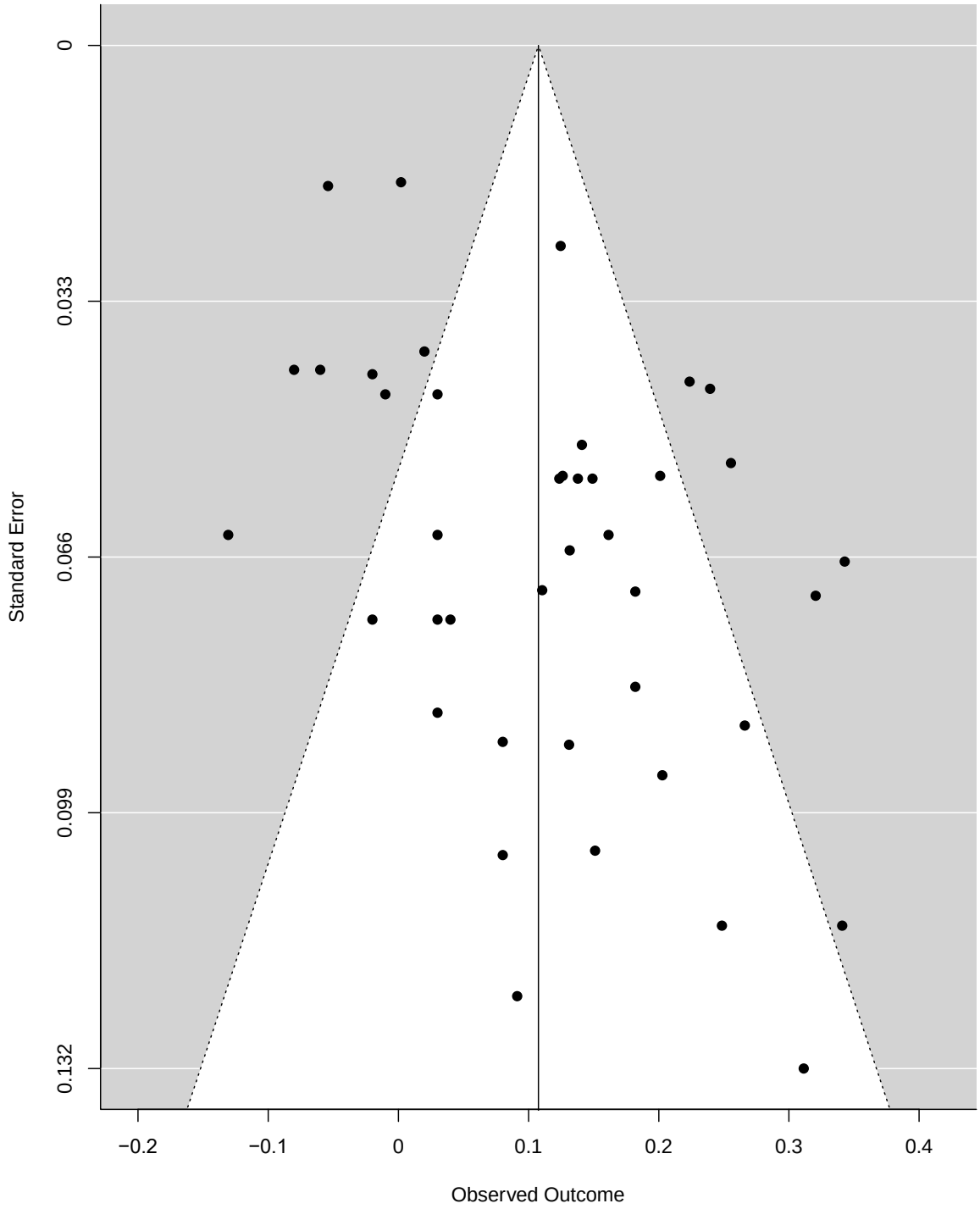
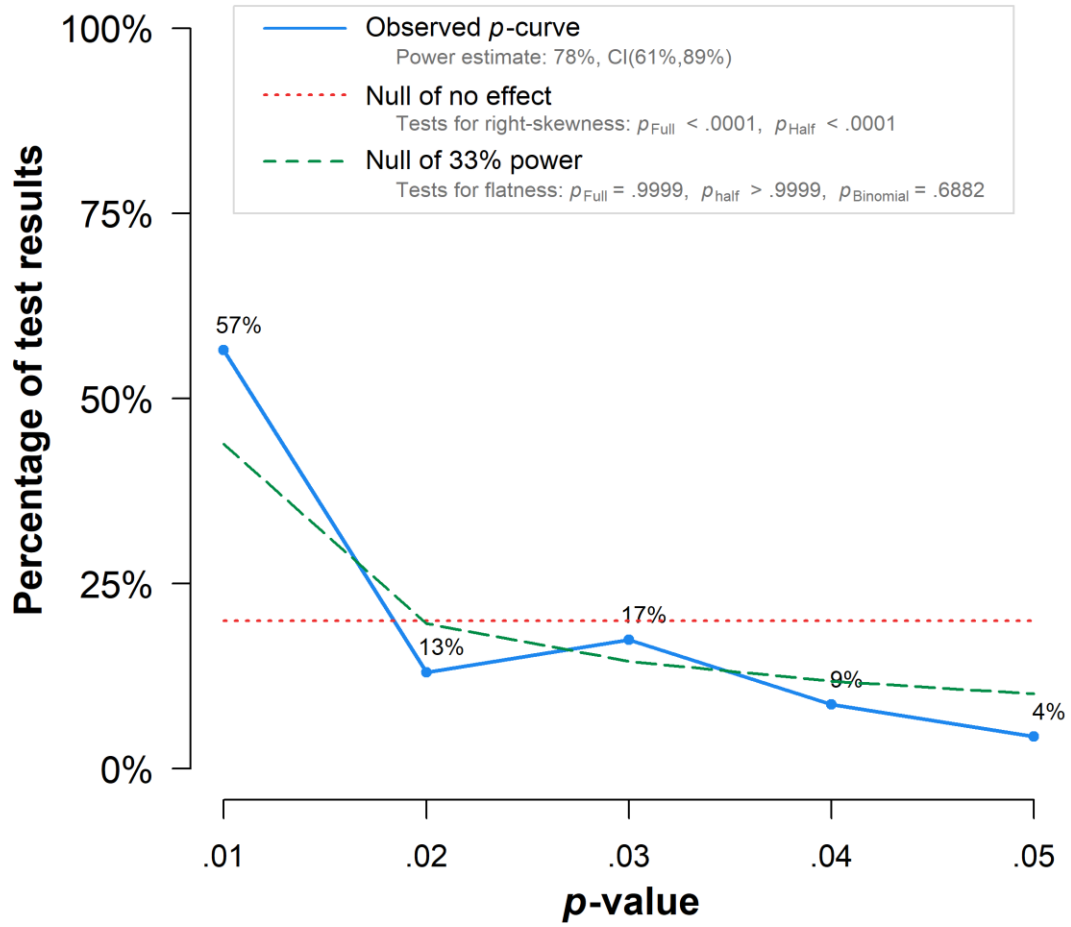


Figure B11. *P*-curve of Conscientiousness and Pro-Environmental Behaviours



Note: The observed *p*-curve includes 23 statistically significant ($p < .05$) results, of which 17 are $p < .025$. There were 18 additional results entered but excluded from *p*-curve because they were $p > .05$.

Figure B12. Forest Plot of Conscientiousness and Pro-Environmental Behaviours

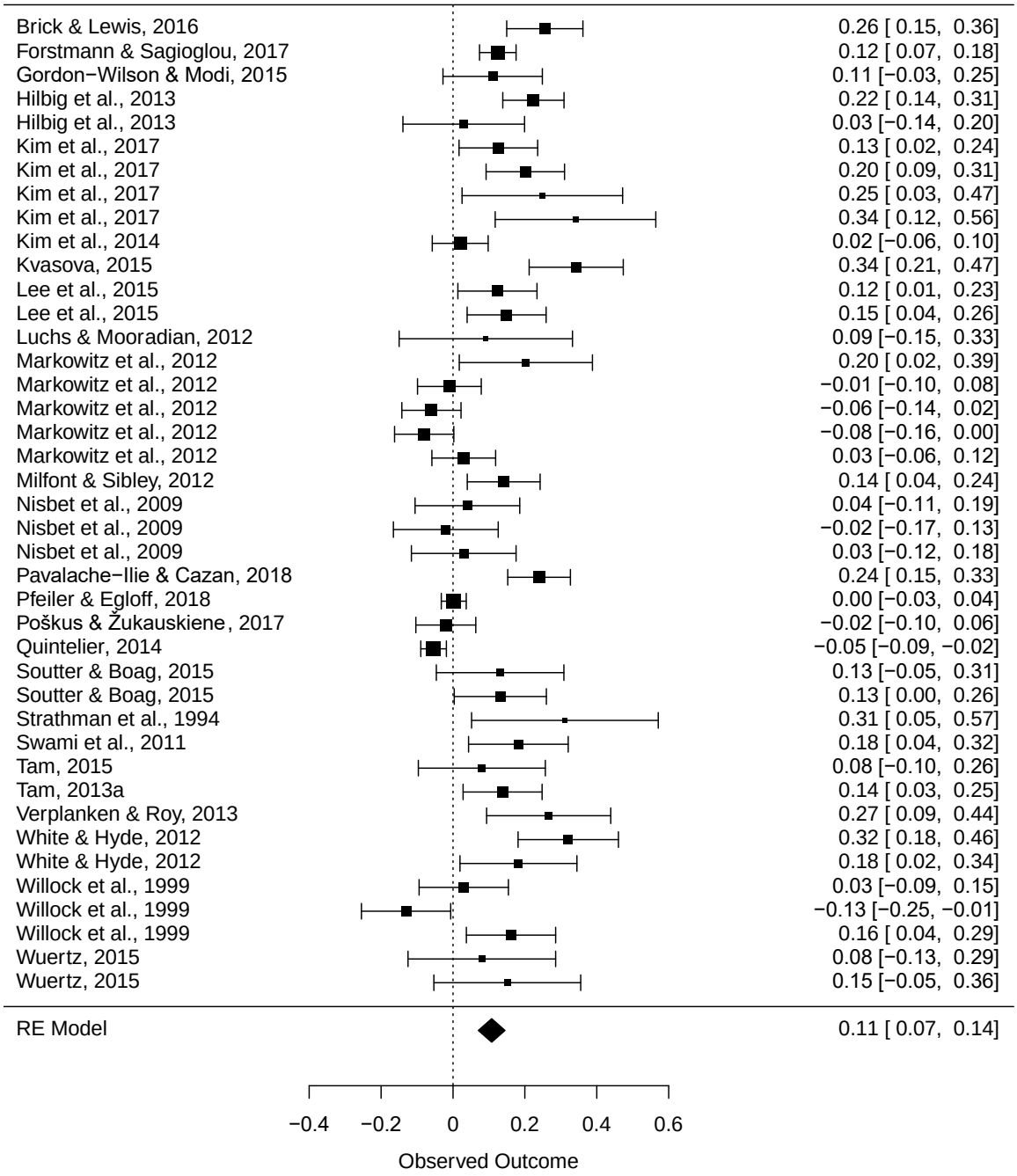


Figure B13. Funnel Plot of Extraversion and Pro-Environmental Attitudes

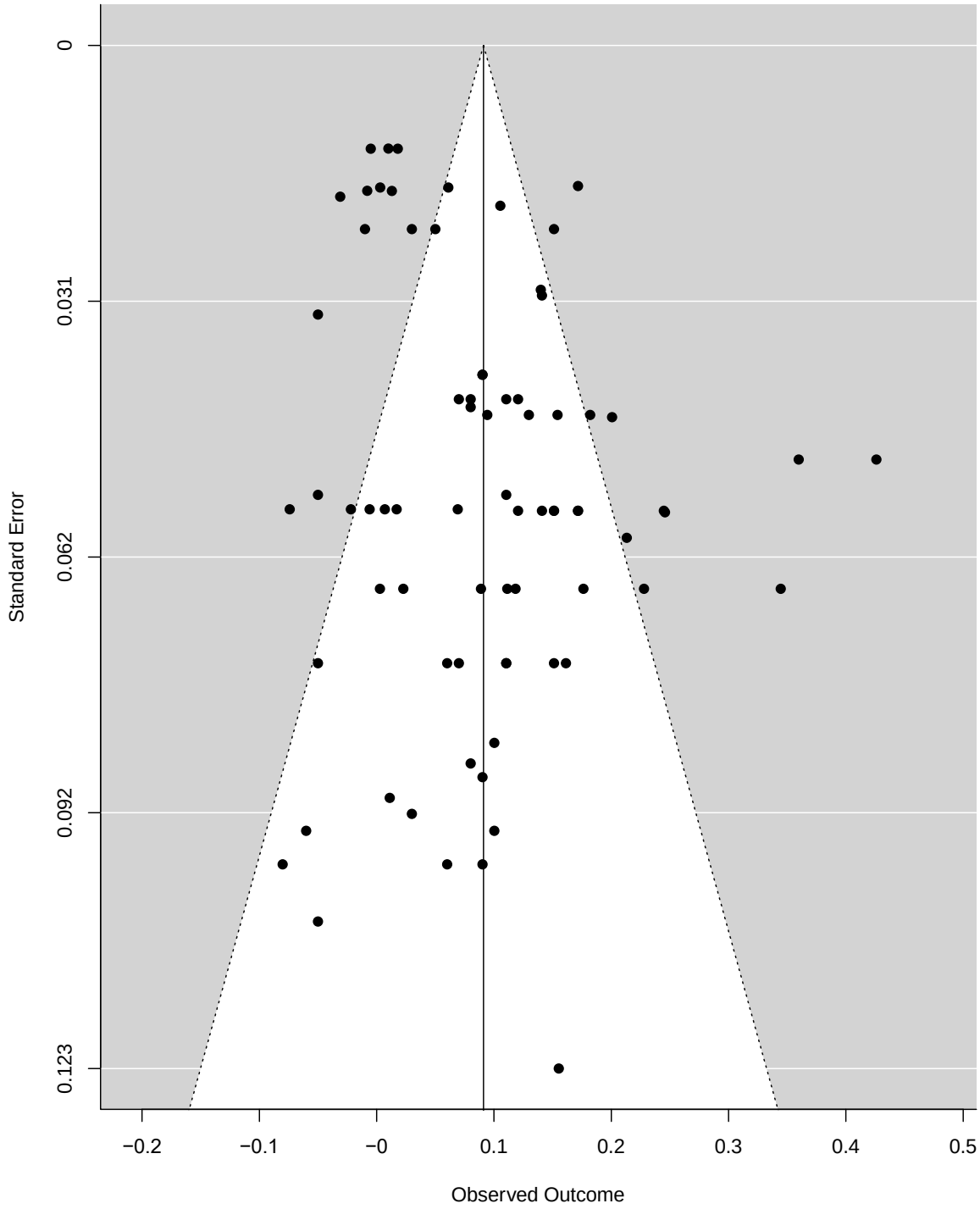
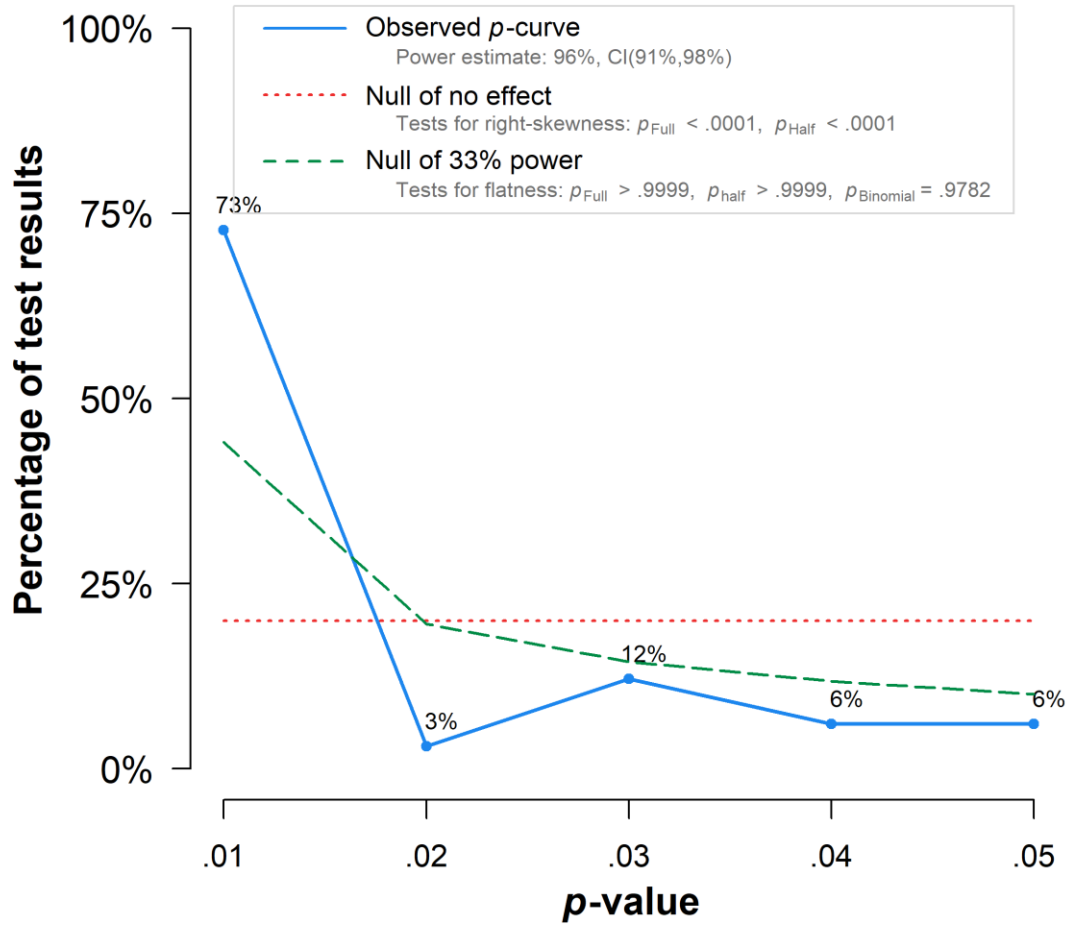


Figure B14. *P*-curve of Extraversion and Pro-Environmental Attitudes



Note: The observed *p*-curve includes 33 statistically significant ($p < .05$) results, of which 28 are $p < .025$. There were 42 additional results entered but excluded from *p*-curve because they were $p > .05$.

Figure B15. Forest Plot of Extraversion and Pro-Environmental Attitudes

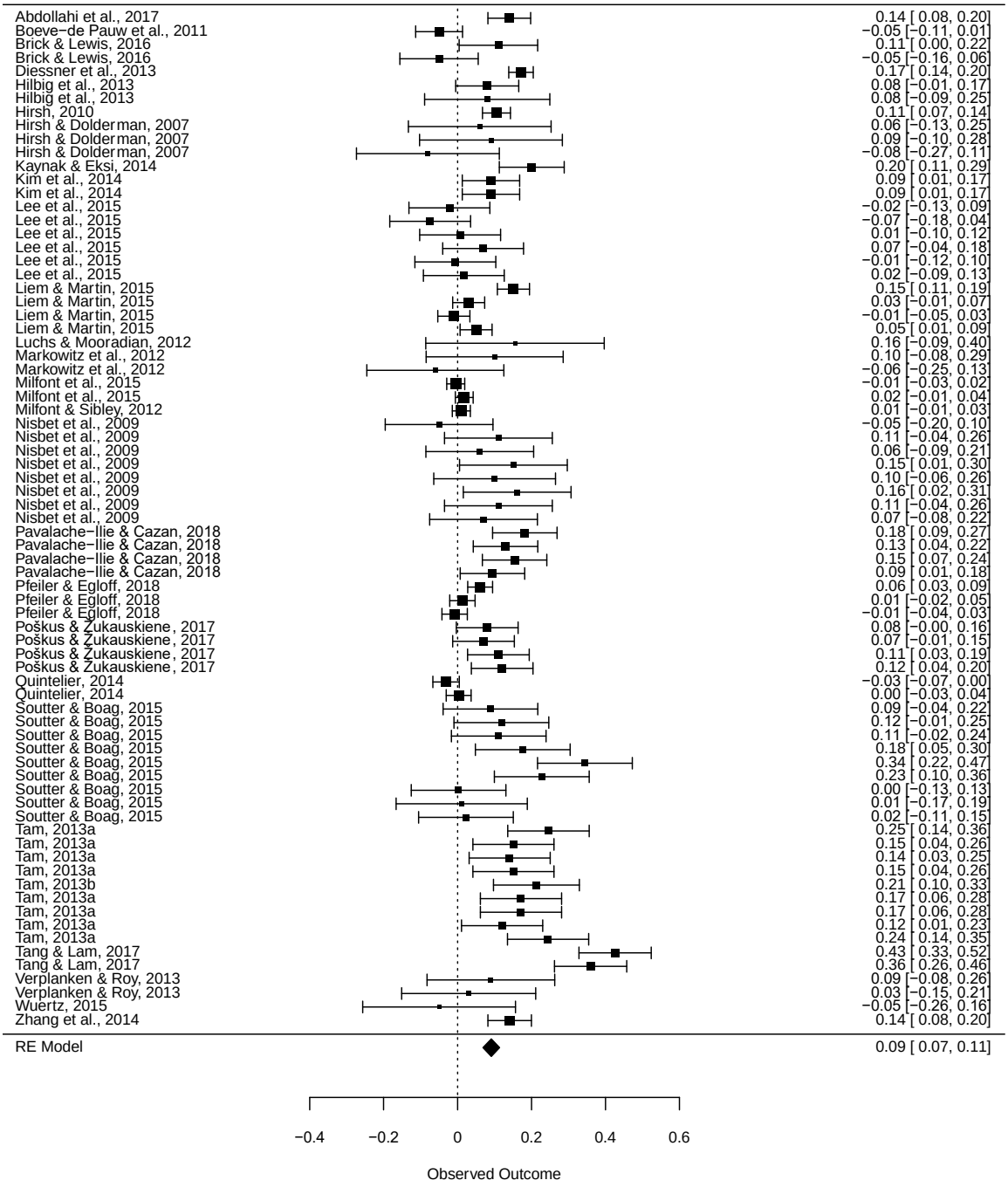


Figure B16. Funnel Plot of Extraversion and Pro-Environmental Behaviours

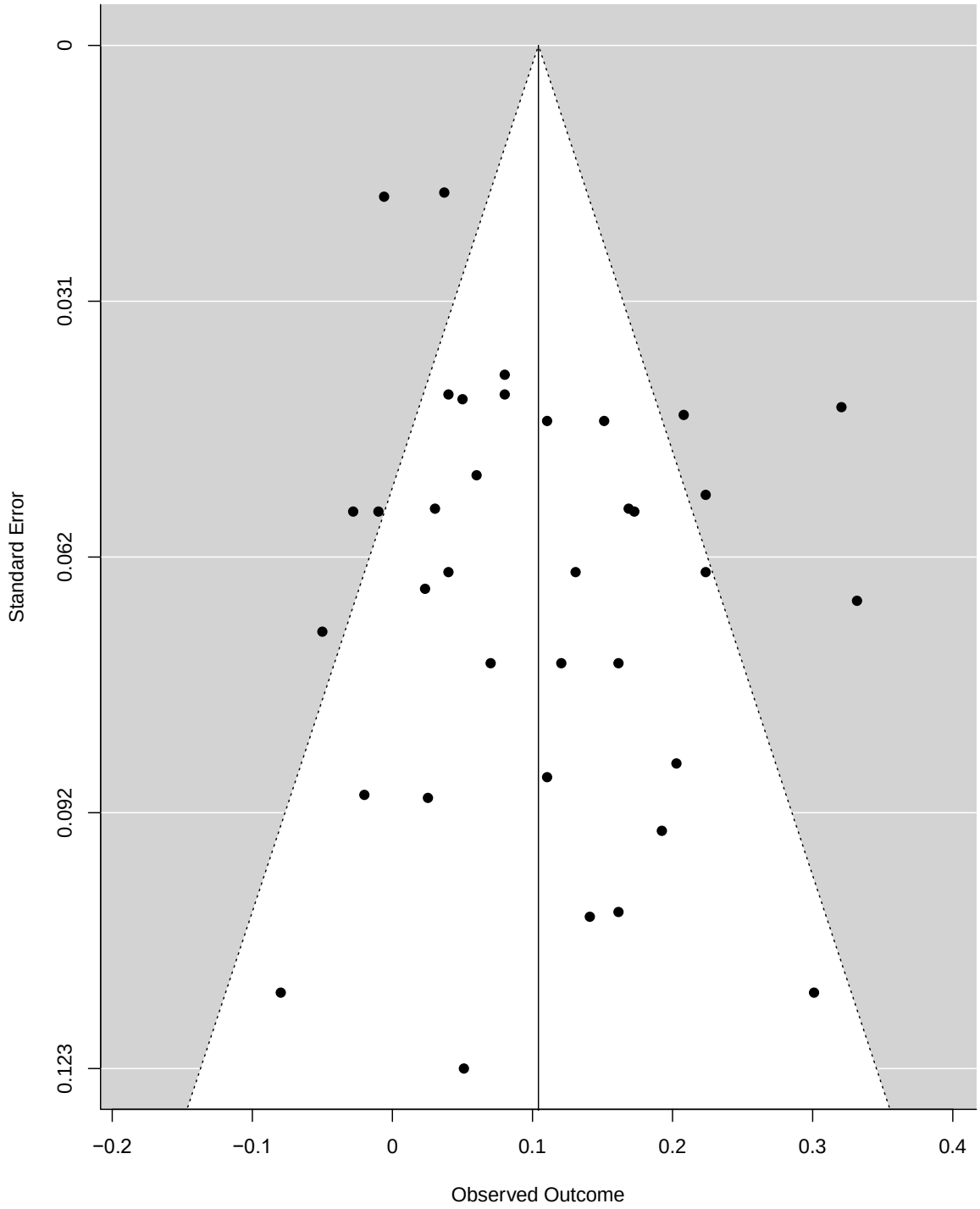
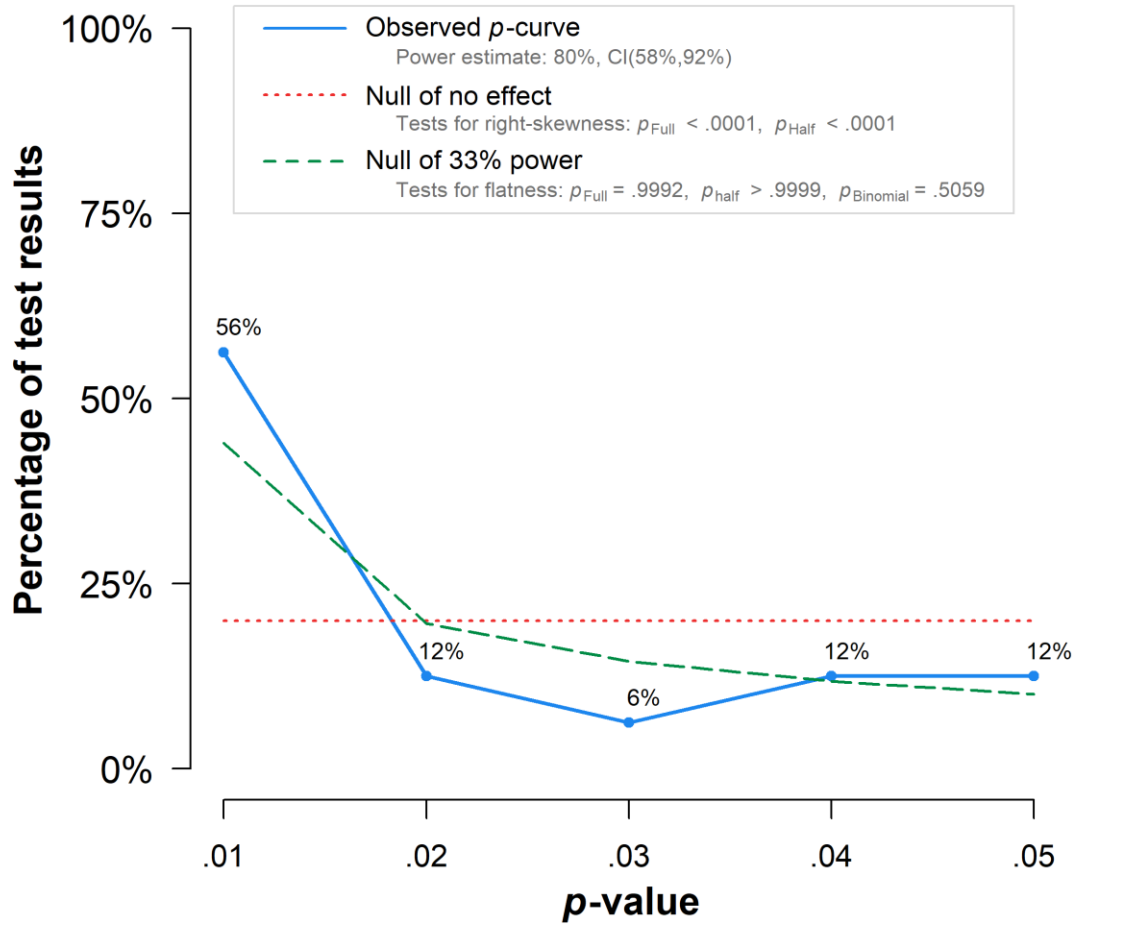


Figure B17. *P*-curve of Extraversion and Pro-Environmental Behaviours



Note: The observed *p*-curve includes 16 statistically significant ($p < .05$) results, of which 11 are $p < .025$. There were 20 additional results entered but excluded from *p*-curve because they were $p > .05$.

Figure B18. Forest Plot of Extraversion and Pro-Environmental Behaviours

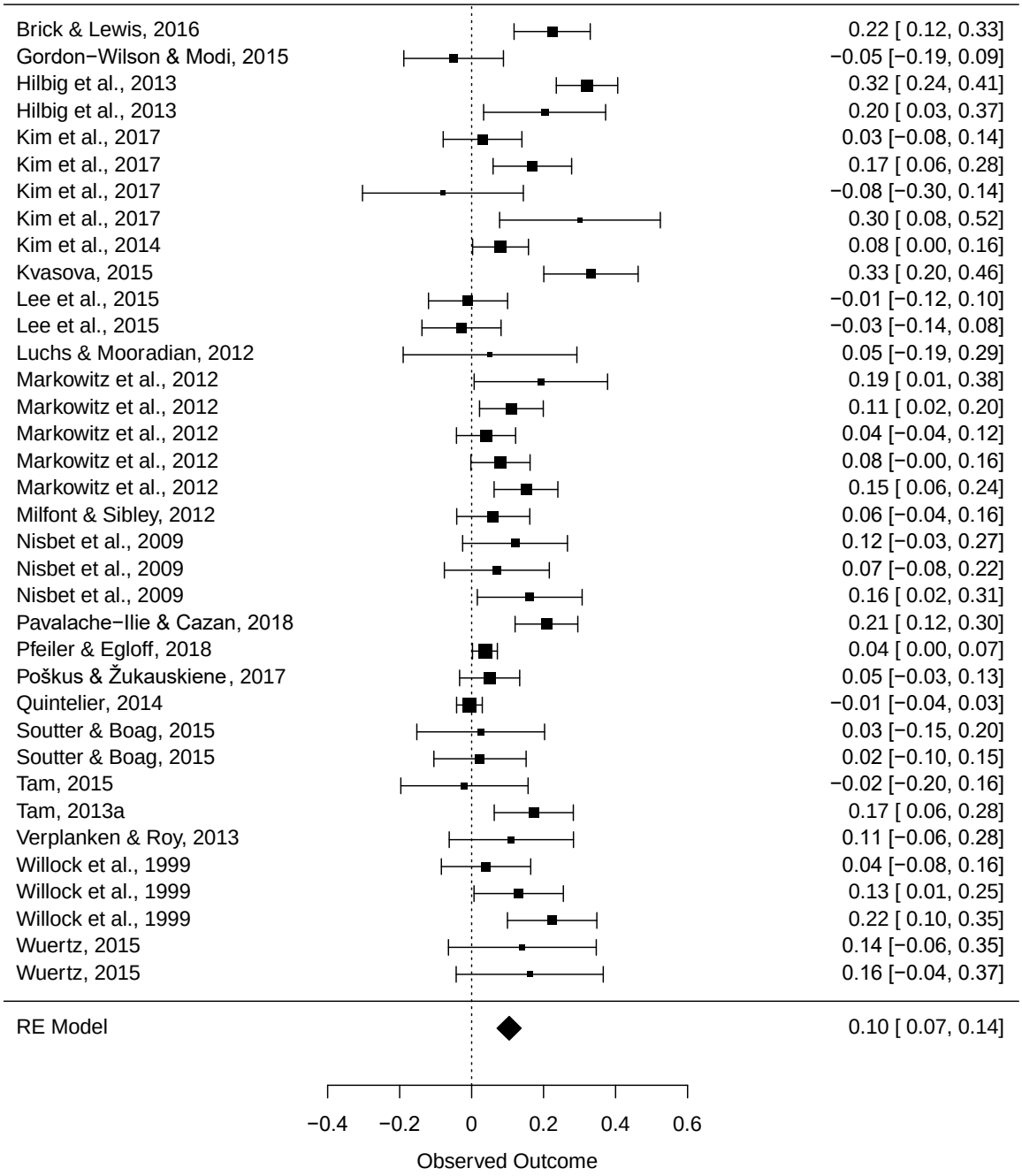


Figure B19. Funnel Plot of Honesty-Humility and Pro-Environmental Attitudes

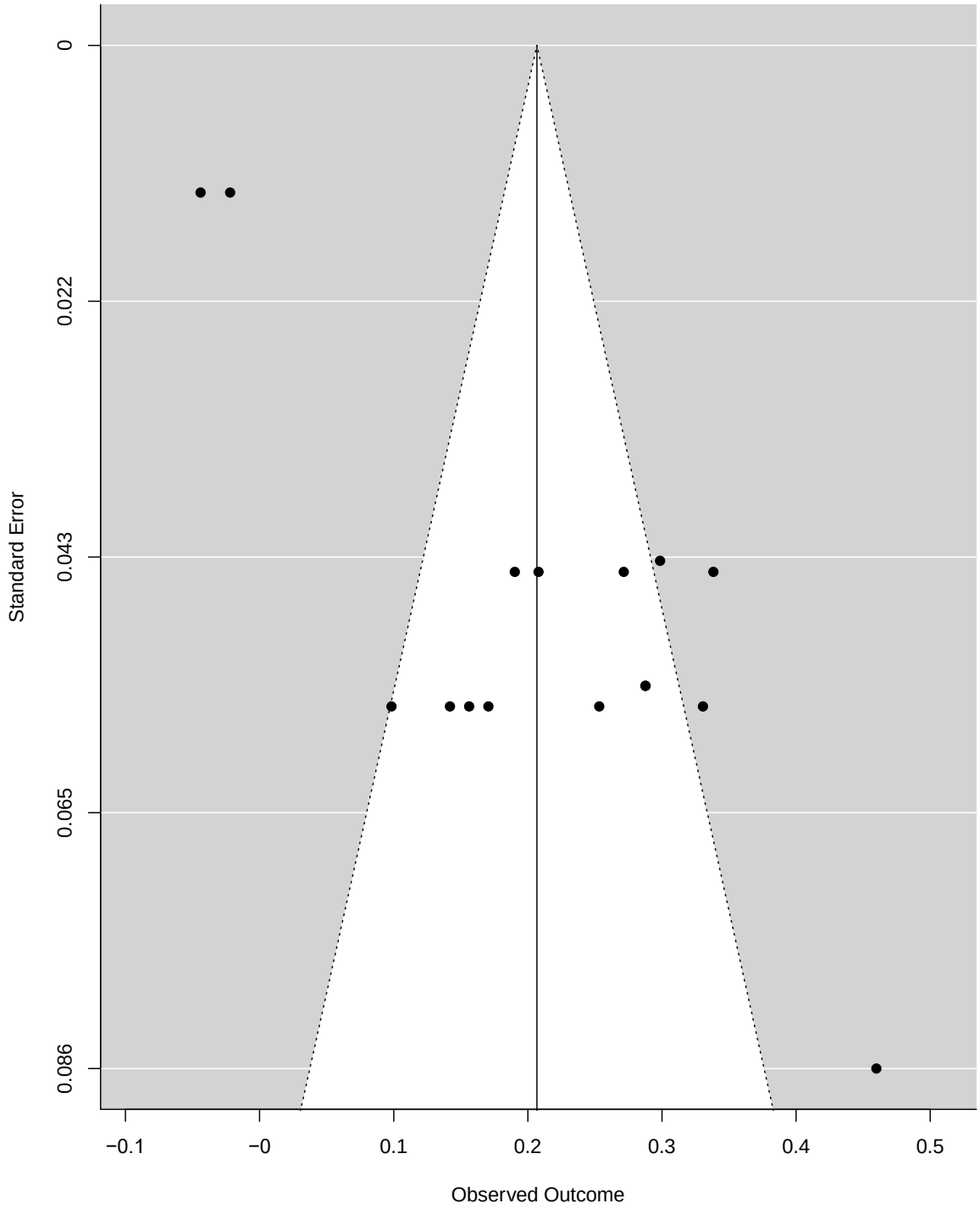
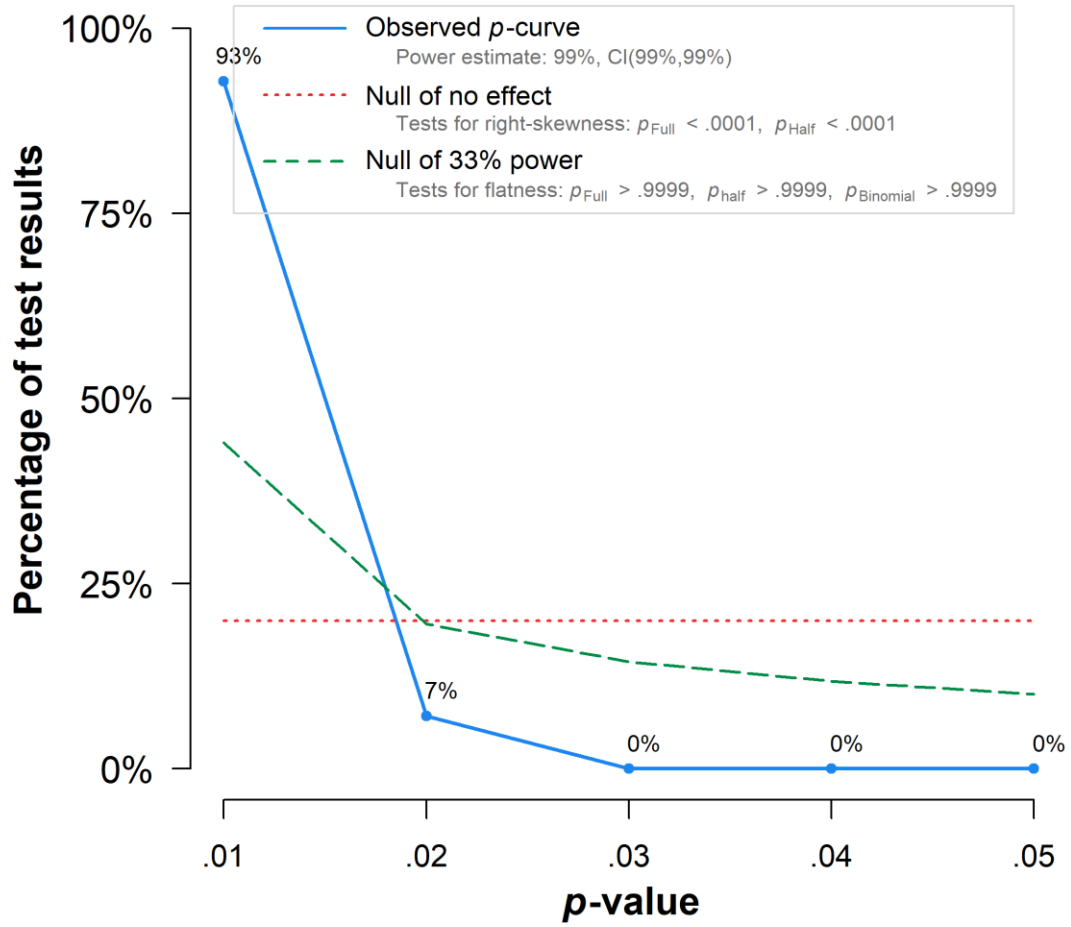


Figure B20. *P*-curve of Honesty-Humility and Pro-Environmental Attitudes



Note: The observed *p*-curve includes 14 statistically significant ($p < .05$) results, of which 14 are $p < .025$. There were 2 additional results entered but excluded from *p*-curve because they were $p > .05$.

Figure B21. Forest Plot of Honesty-Humility and Pro-Environmental Attitudes

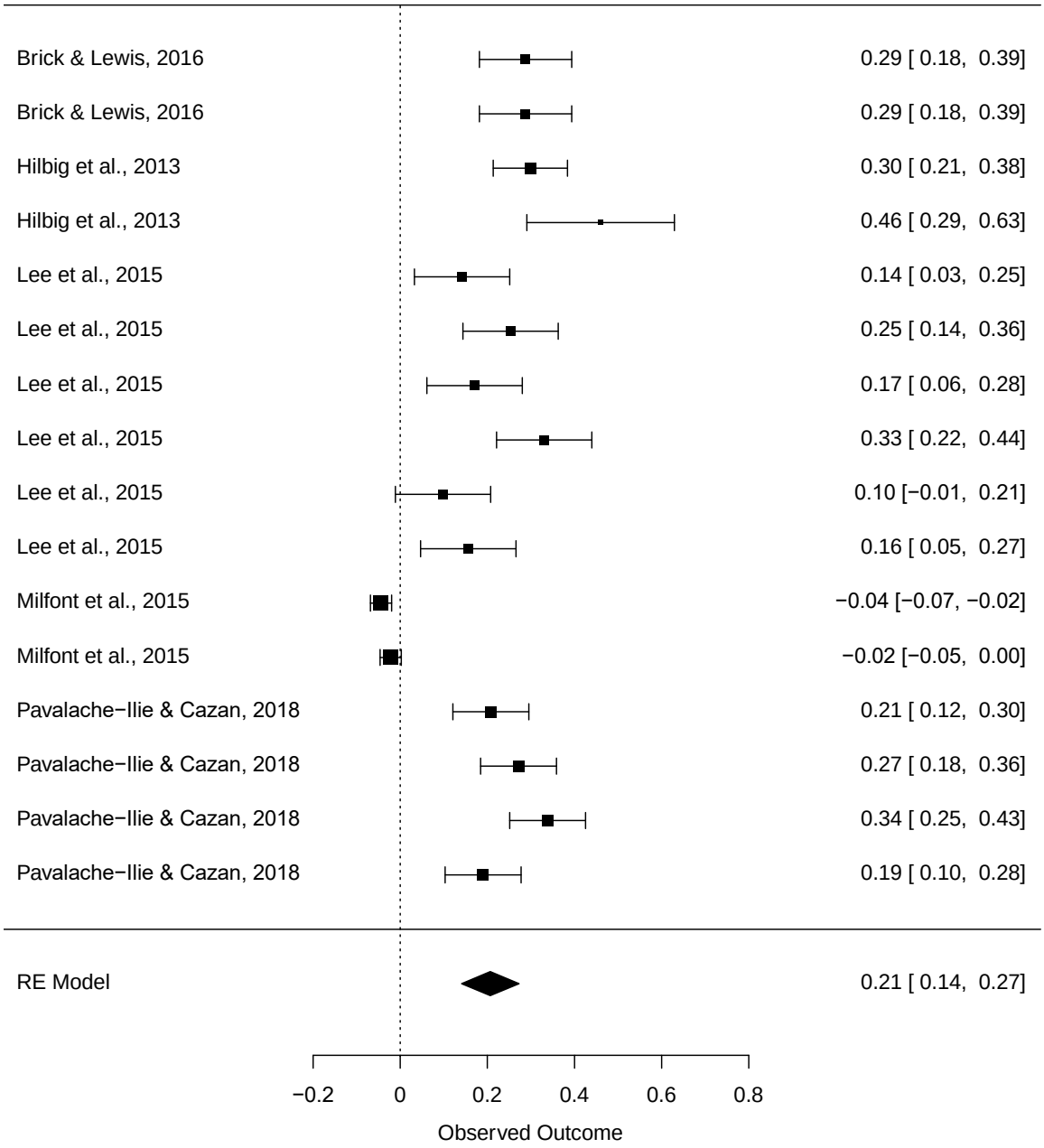


Figure B22. Funnel Plot of Honesty-Humility and Pro-Environmental Behaviours

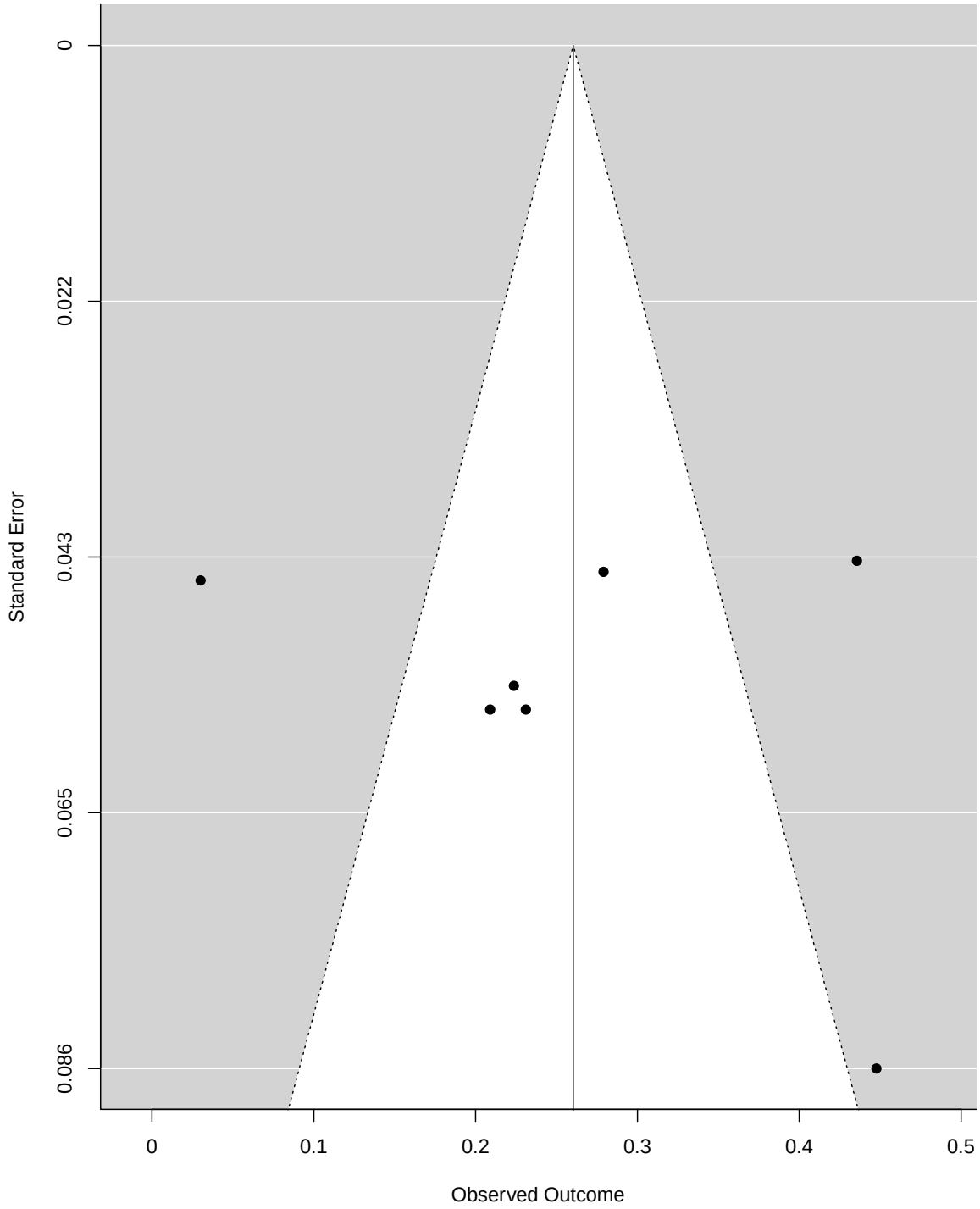
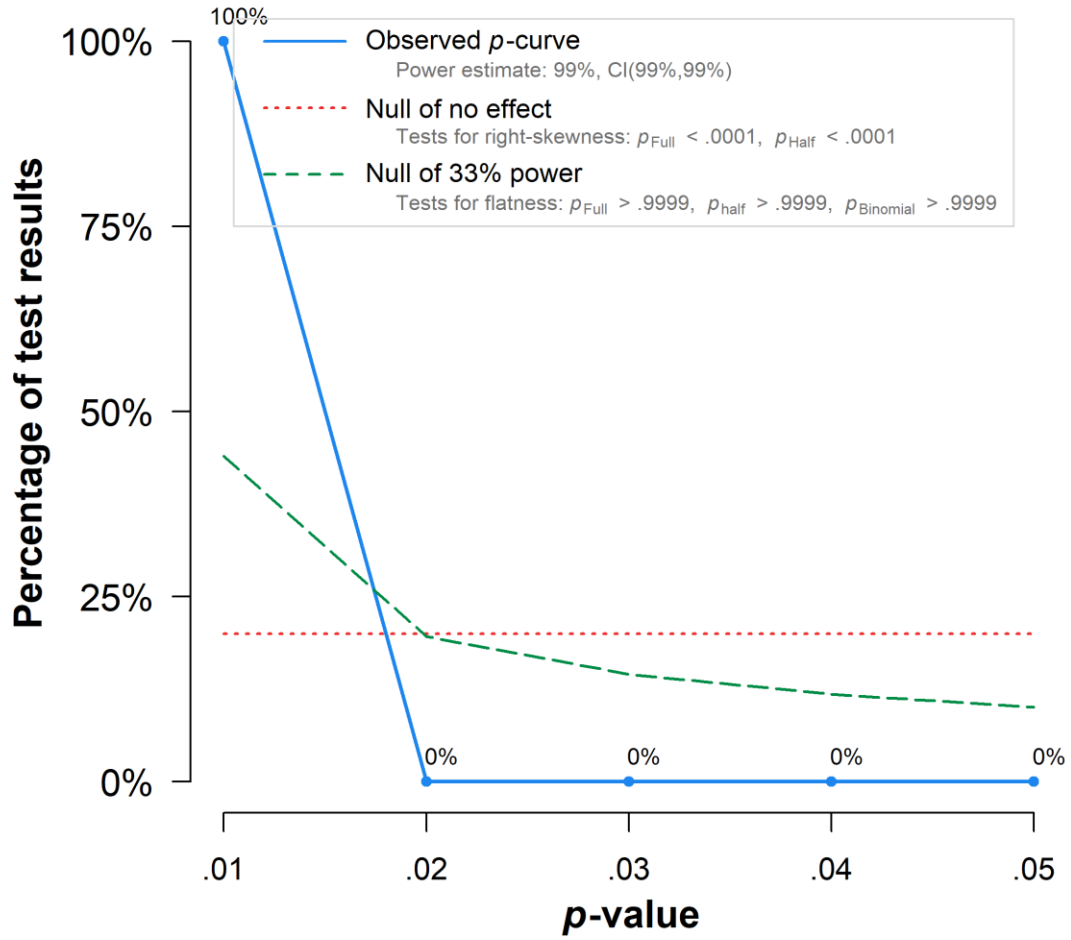


Figure B23. *P*-curve of Honesty-Humility and Pro-Environmental Behaviours



Note: The observed *p*-curve includes 6 statistically significant ($p < .05$) results, of which 6 are $p < .025$. There was one additional result entered but excluded from *p*-curve because it was $p > .05$.

Figure B24. Forest Plot of Honesty-Humility and Pro-Environmental Behaviours

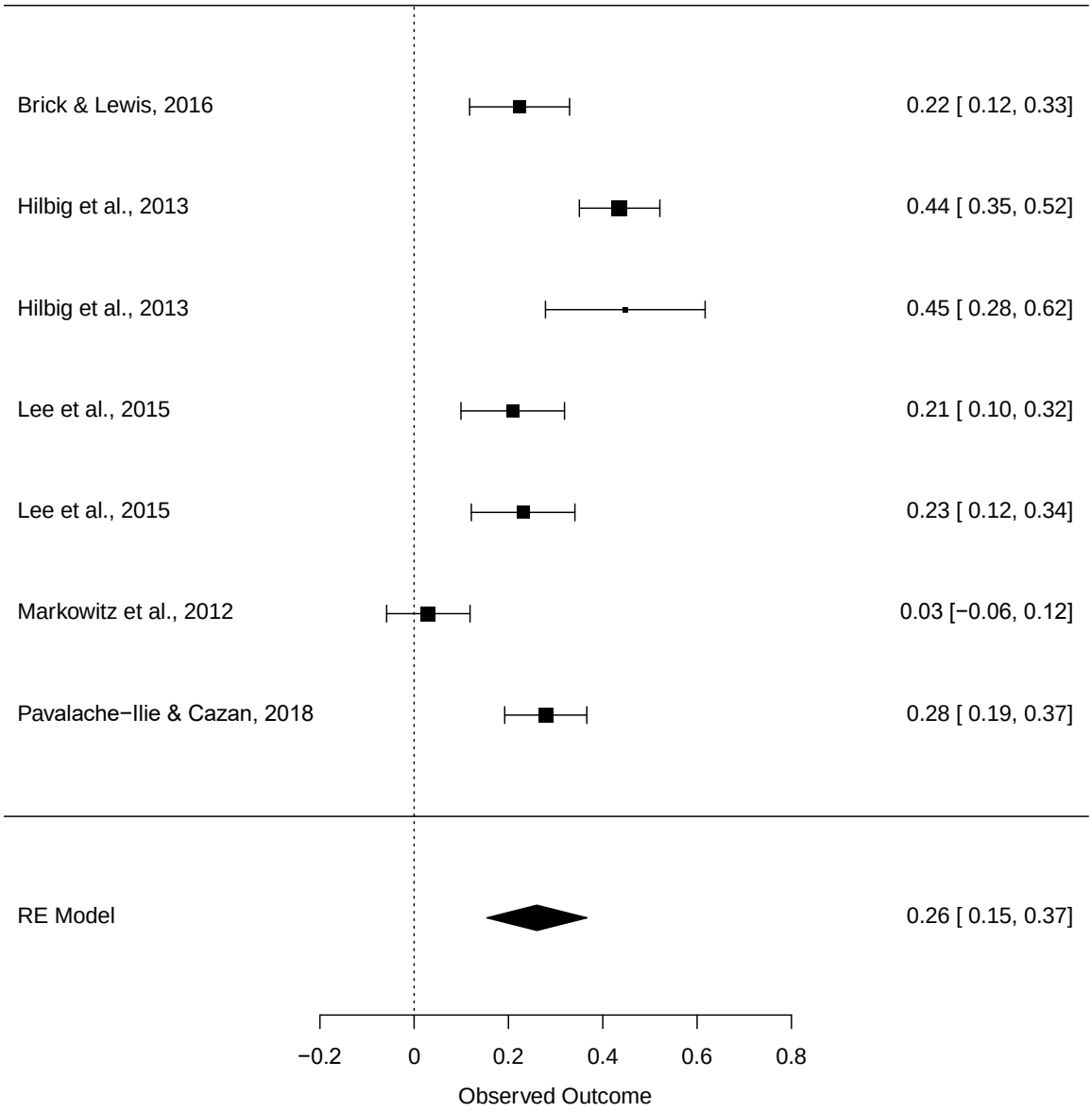


Figure B25. Funnel Plot of Neuroticism and Pro-Environmental Attitudes

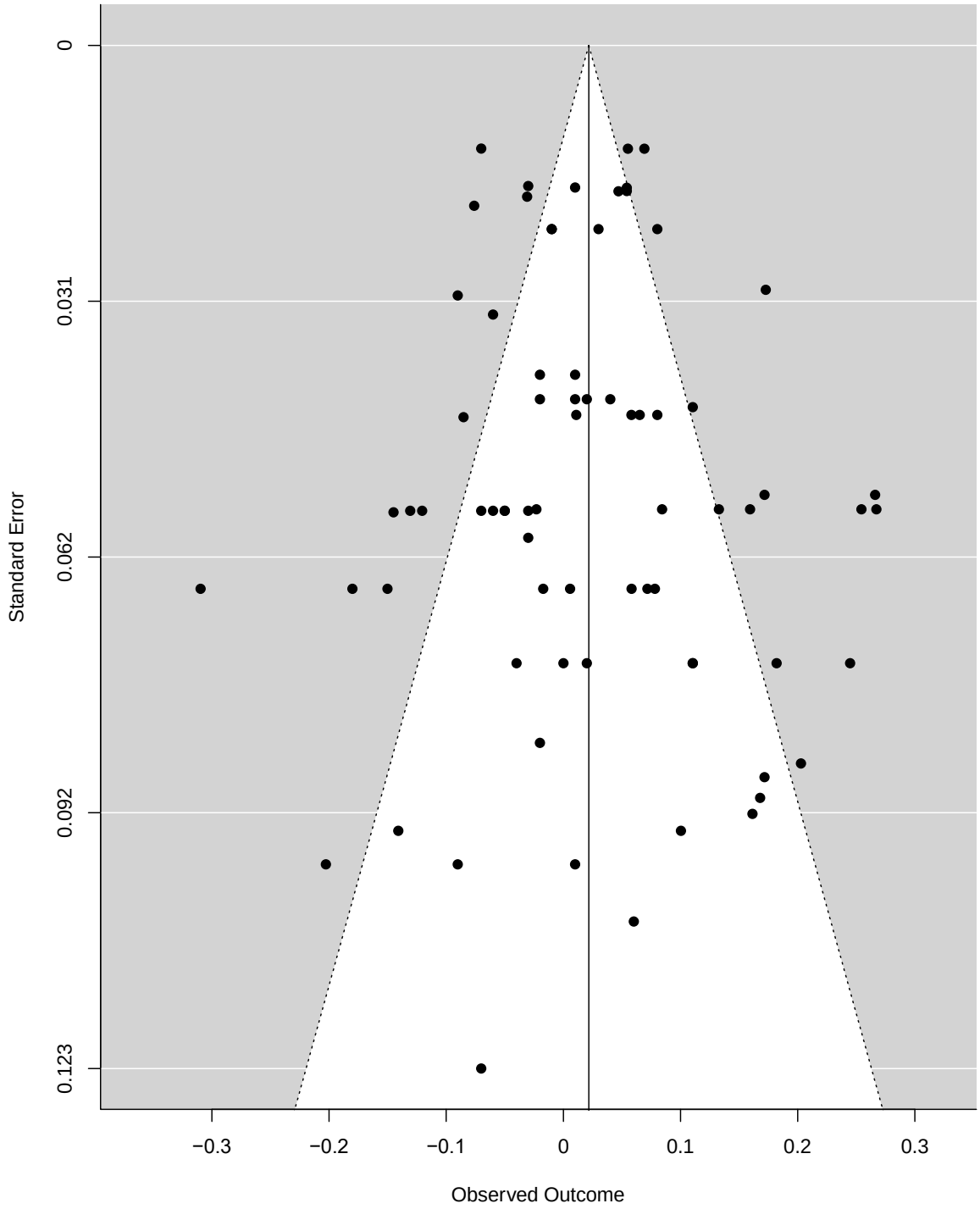
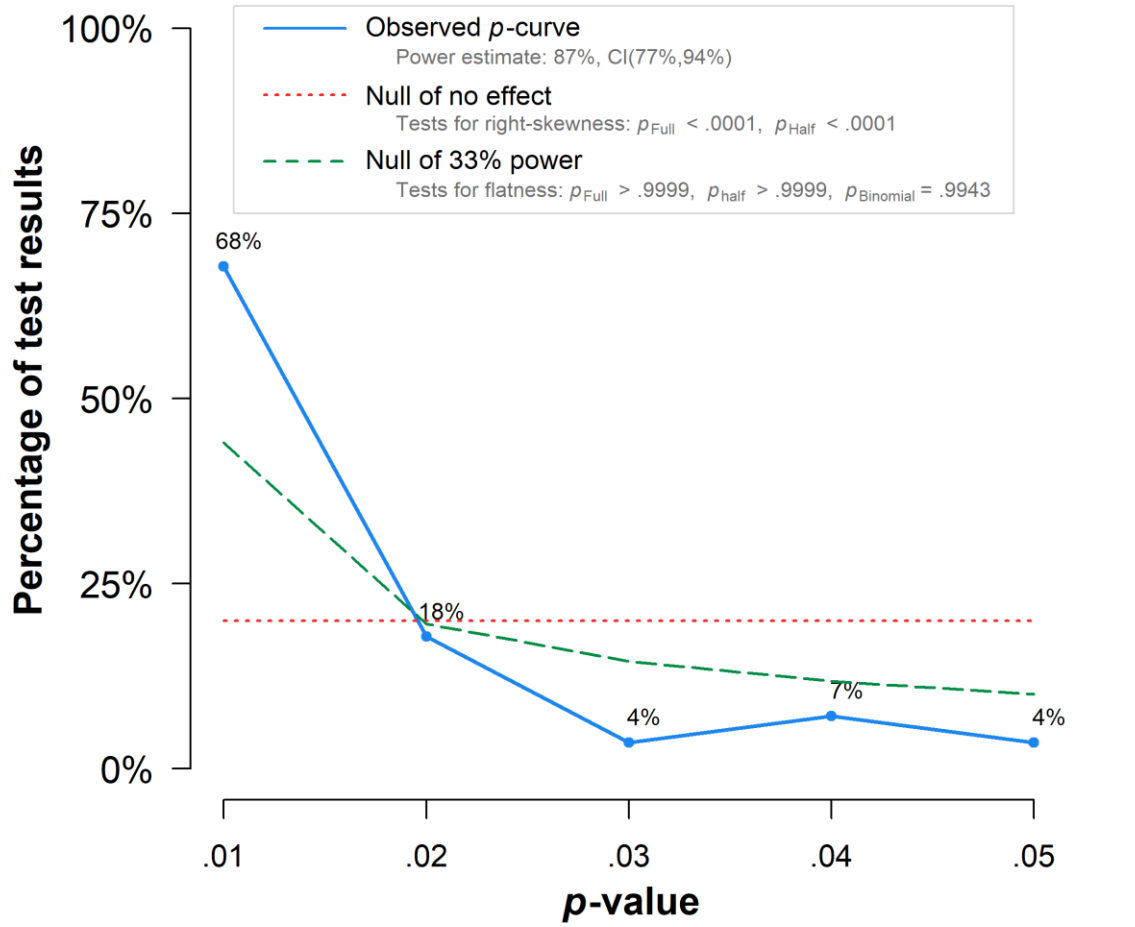


Figure B26. *P*-curve of Neuroticism and Pro-Environmental Attitudes



Note: The observed *p*-curve includes 28 statistically significant ($p < .05$) results, of which 25 are $p < .025$. There were 45 additional results entered but excluded from *p*-curve because they were $p > .05$.

Figure B27. Forest Plot of Neuroticism and Pro-Environmental Attitudes

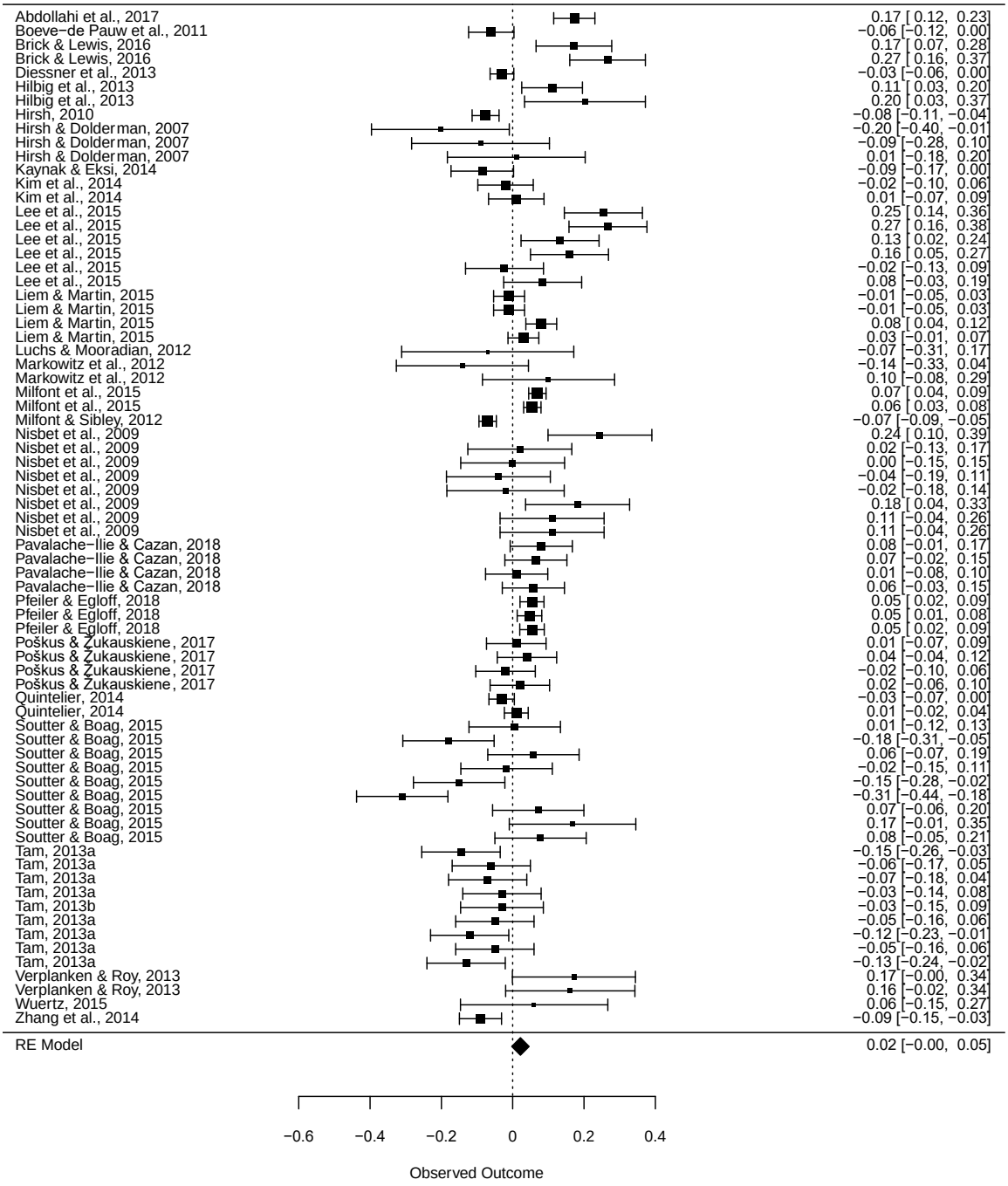


Figure B28. Funnel Plot of Neuroticism and Pro-Environmental Behaviours

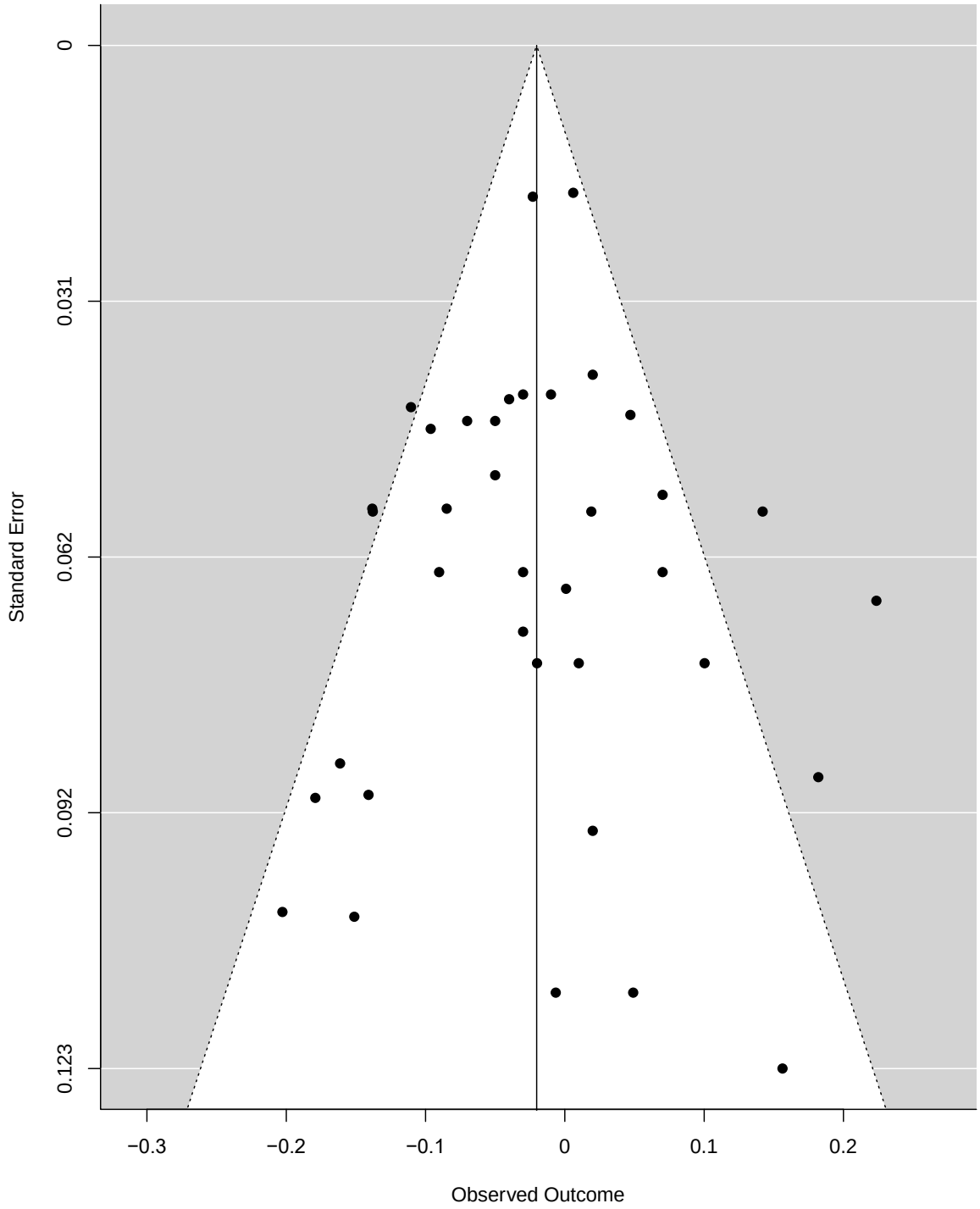
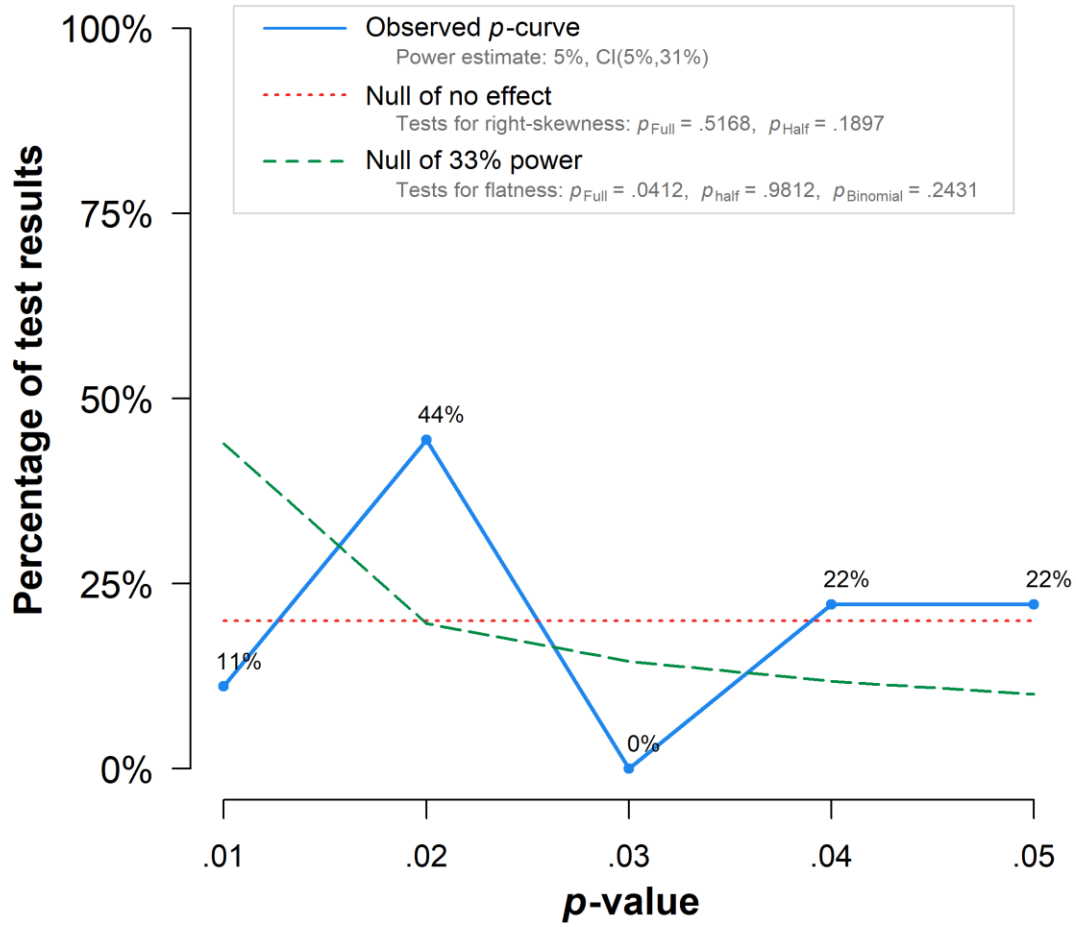


Figure B29. *P*-curve of Neuroticism and Pro-Environmental Behaviours



Note: The observed *p*-curve includes 9 statistically significant ($p < .05$) results, of which 5 are $p < .025$. There were 28 additional results entered but excluded from *p*-curve because they were $p > .05$.

Figure B30. Forest Plot of Neuroticism and Pro-Environmental Behaviours

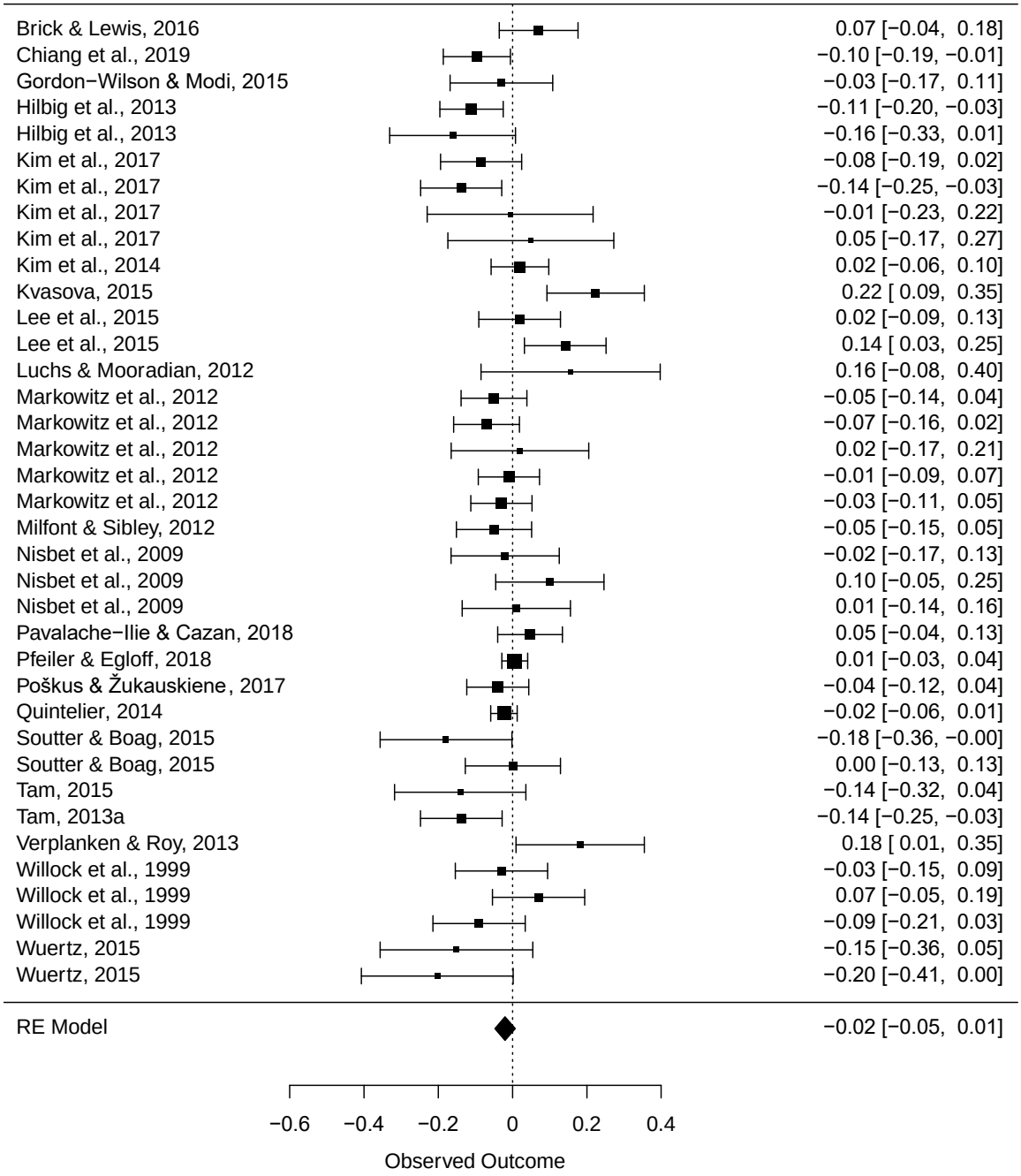


Figure B31. Funnel Plot of Openness and Pro-Environmental Attitudes

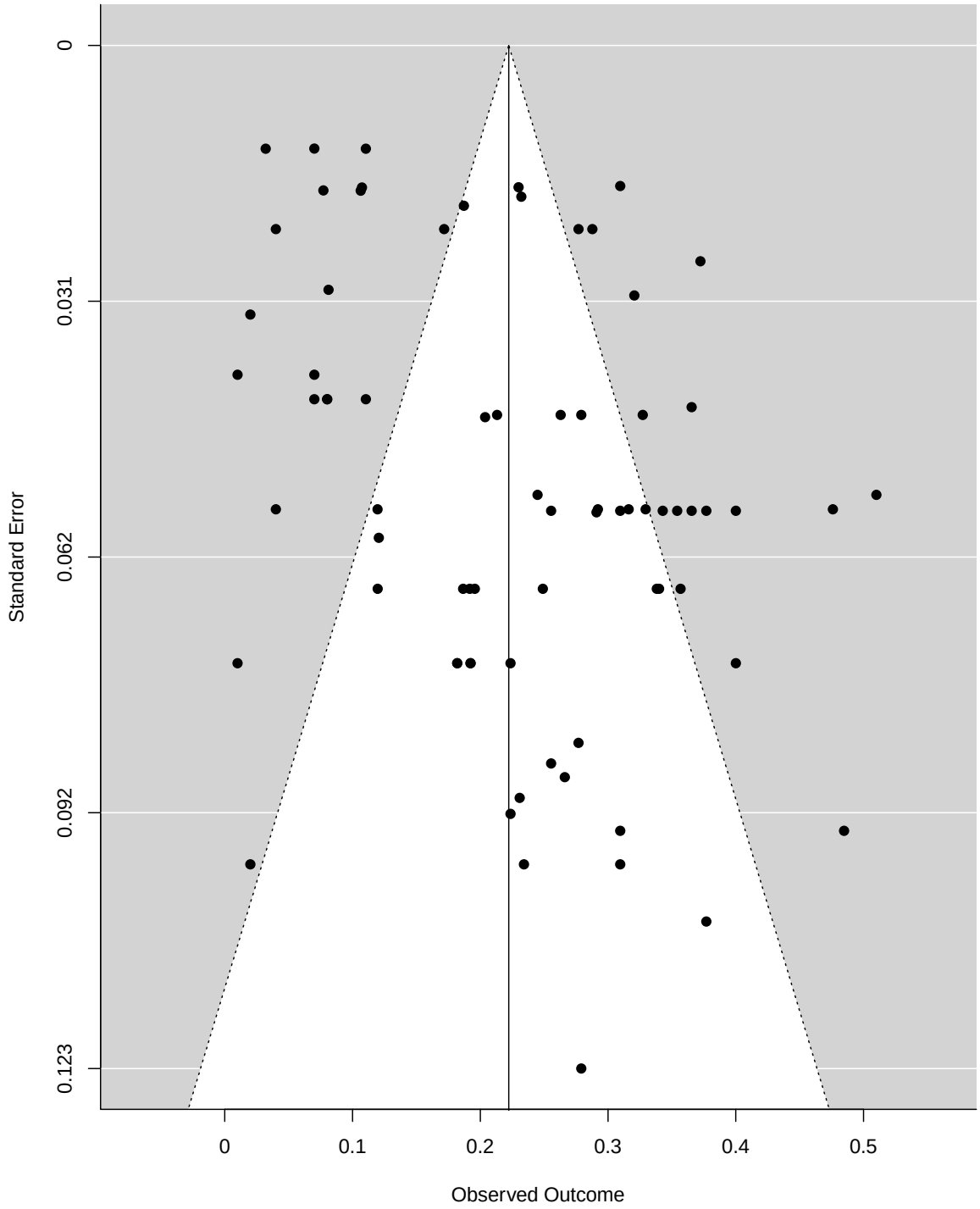
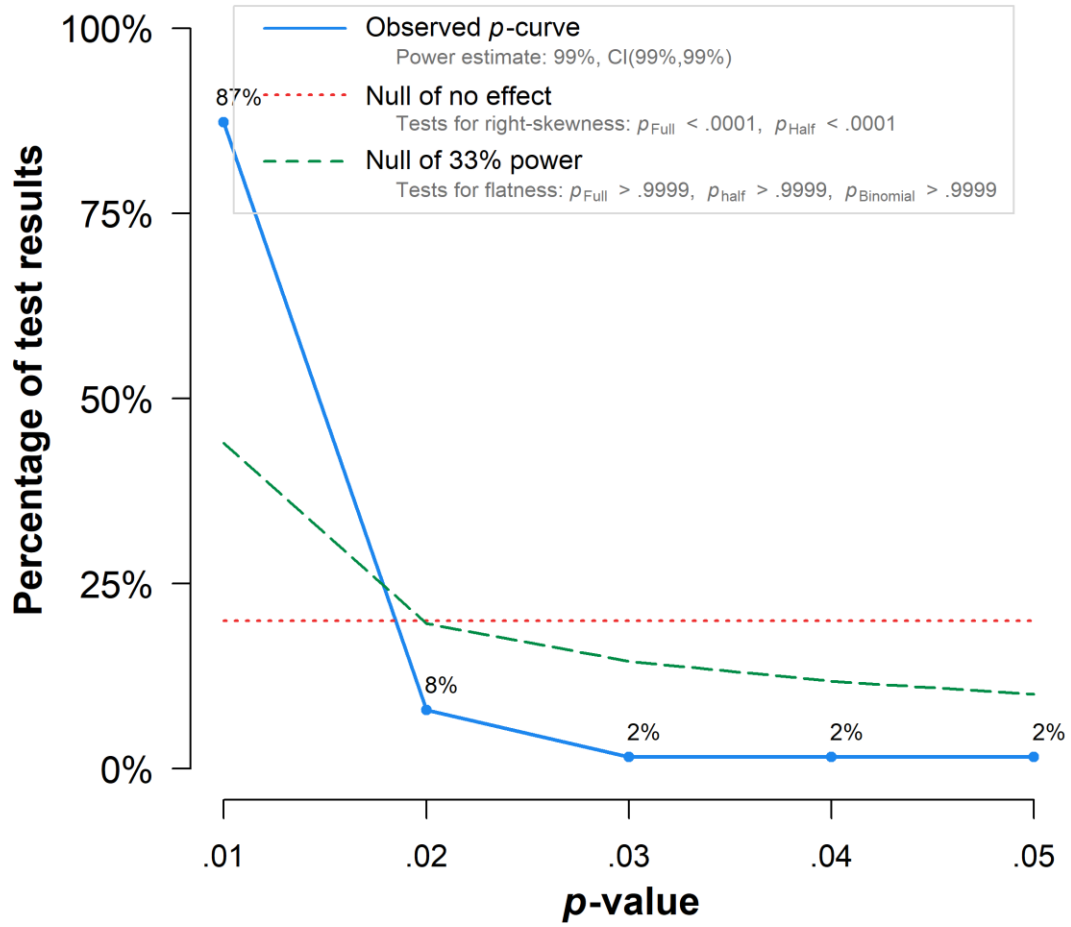


Figure B32. *P*-curve of Openness and Pro-Environmental Attitudes



Note: The observed *p*-curve includes 63 statistically significant ($p < .05$) results, of which 61 are $p < .025$. There were 11 additional results entered but excluded from *p*-curve because they were $p > .05$.

Figure B33. Forest Plot of Openness and Pro-Environmental Attitudes

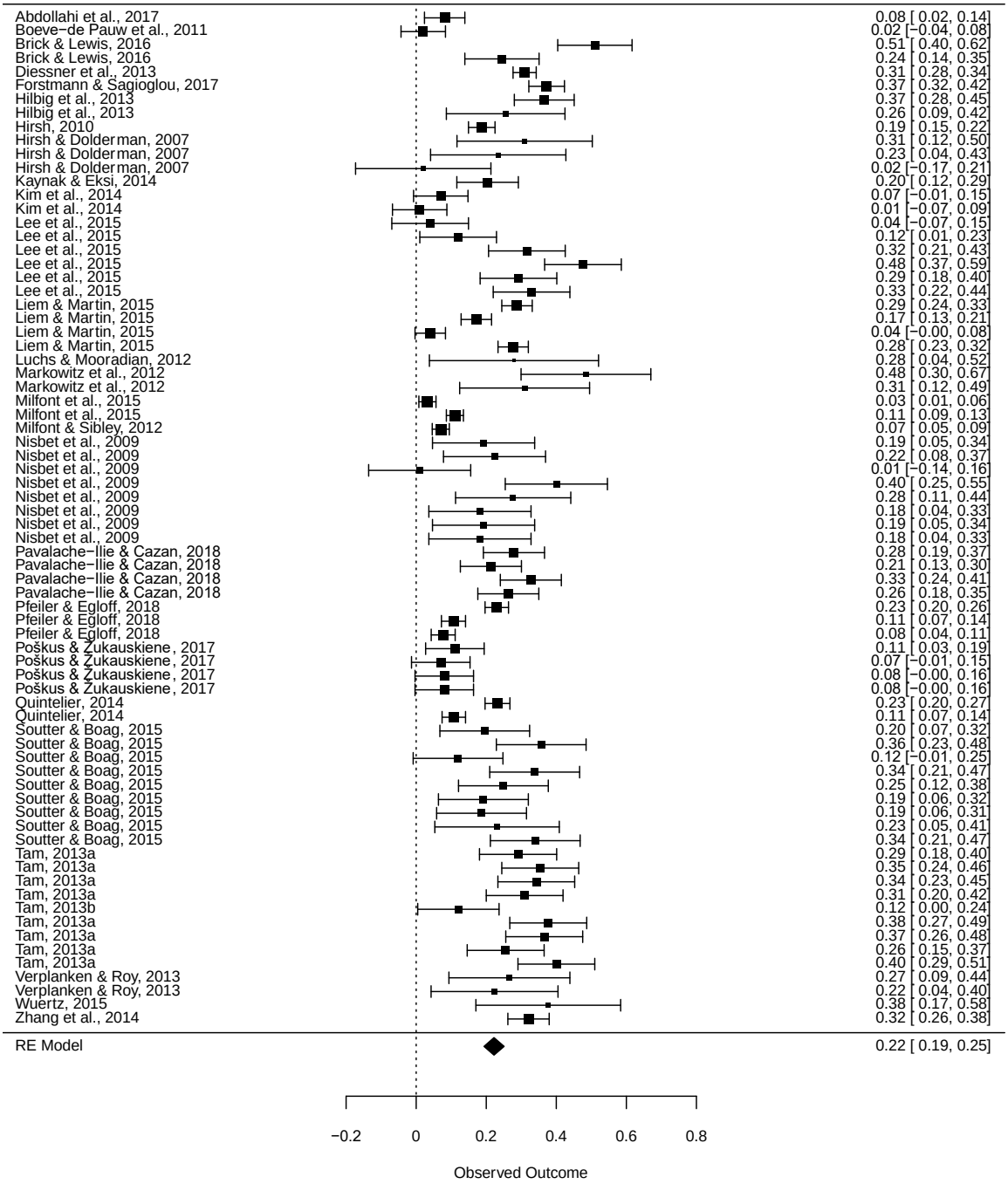


Figure B34. Funnel Plot of Openness and Pro-Environmental Behaviours

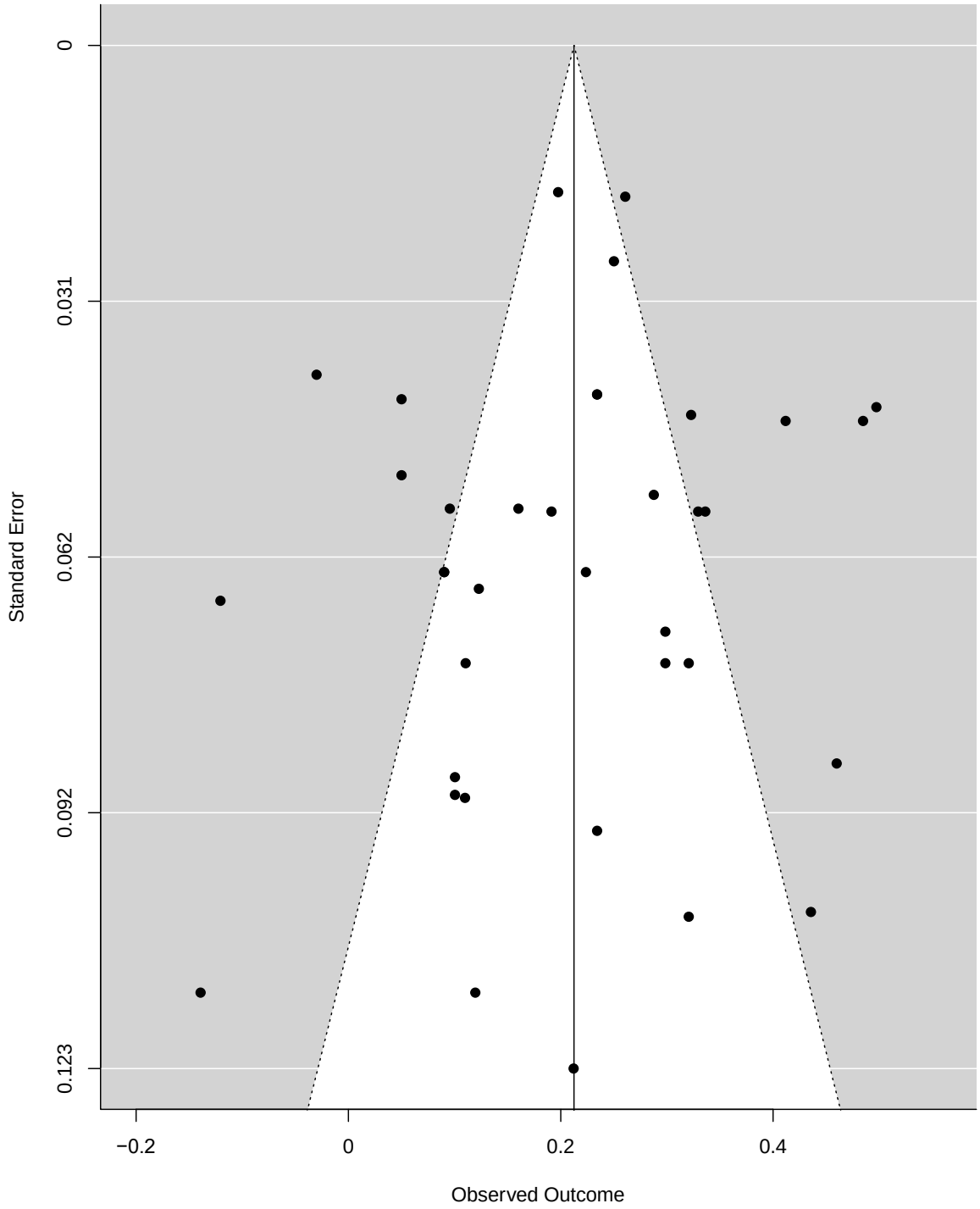
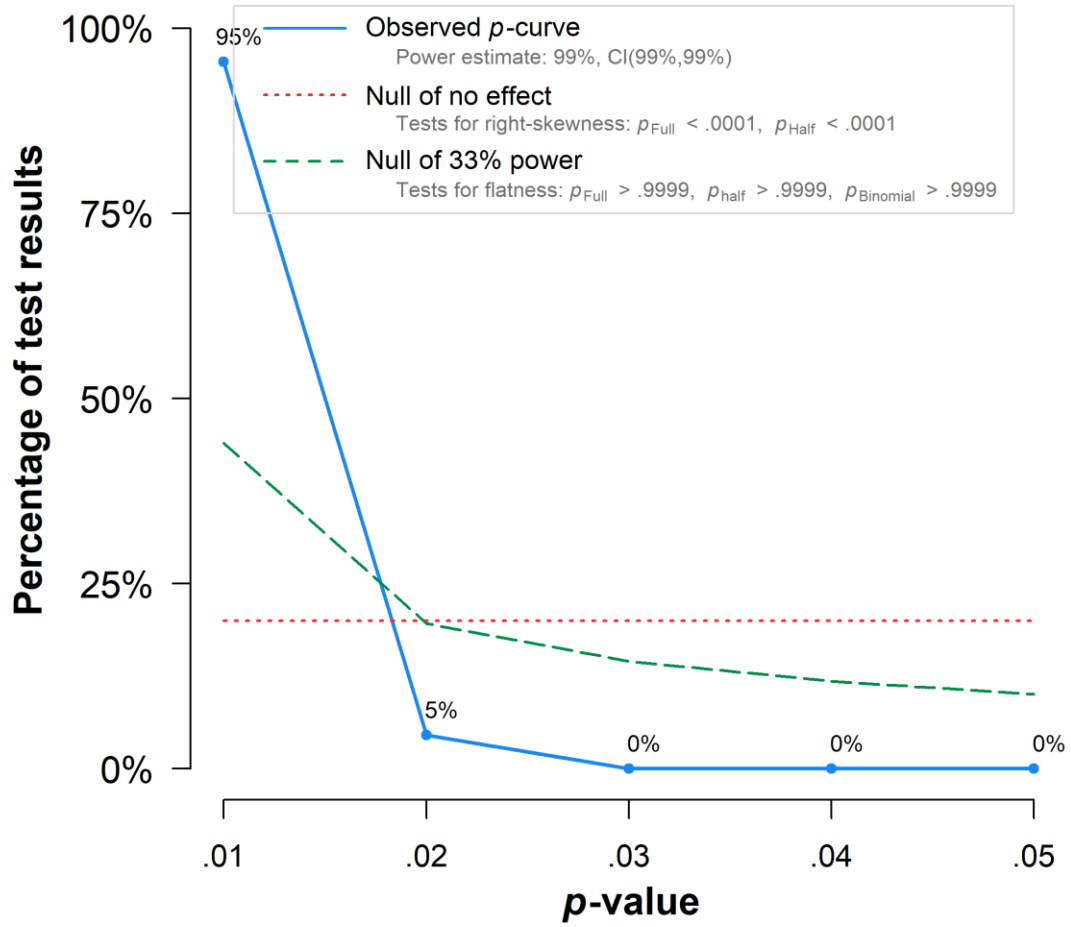
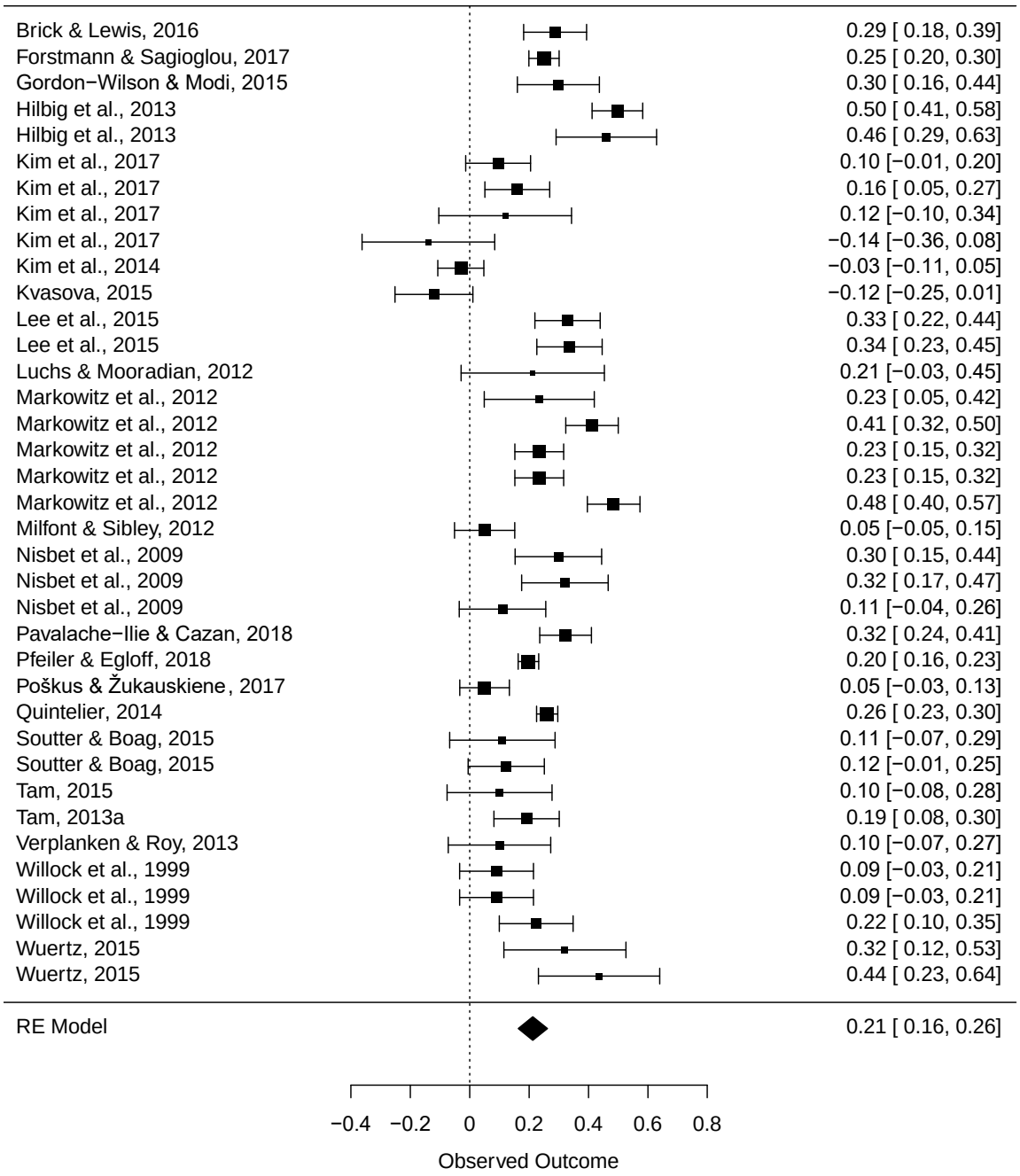


Figure B35. *P*-curve of Openness and Pro-Environmental Behaviours



Note: The observed *p*-curve includes 22 statistically significant ($p < .05$) results, of which 22 are $p < .025$. There were 15 additional results entered but excluded from *p*-curve because they were $p > .05$.

Figure B36. Forest Plot of Openness and Pro-Environmental Behaviours



Appendix C.1: Meta-Analysis Correlation Comparisons

In Chapter 5 we examined how the facets within the Big Five were associated with pro-environmental attitudes and behaviours. This was assessed via a meta-analysis across two existing datasets. In this chapter we stated that among the facets of Openness, that Artistic Interests had the strongest associations with pro-environmental attitudes and behaviours, with Intellect and Liberalism being comparatively strongly associated. Among the facets of Agreeableness, it was stated that Sympathy and Altruism had the strongest associations with pro-environmental attitudes and behaviours. However, we did not statistically assess these claims. Thus, we performed an analysis to compare facet correlations for Openness and Agreeableness, to assess whether these identified facets were statistically different to the other facets within their respective domain.

To do this we statistically compared correlations using the r.test() function as part of the psych package (Revelle, 2020). Correlations between facets (r23) were meta-analytically created. For Openness, we compared how Artistic Interests', Liberalism's, and Intellect's correlations with pro-environmental attitudes and behaviours compared with each other and the other facets of Openness. For Agreeableness, we compared how Sympathy's and Altruism's correlations with pro-environmental attitudes and behaviours compared with each other and the other facets of Agreeableness. To control for multiple comparisons, we performed Bonferroni adjustments (critical $\alpha = .004$ and .006 for Openness and Agreeableness respectively). These comparisons can be found in Table C.1.1.

Table C.1.1. Meta-Analytic Correlation Comparisons

Domain	Facet 1	Facet 2	Attitudes	Behaviours
			t	*t*
Openness	Artistic Interests	Imagination	4.15*	6.33*
Openness	Artistic Interests	Emotionality	2.33	4.74*
Openness	Artistic Interests	Adventurousness	6.39*	3.87*
Openness	Artistic Interests	Intellect	2.22	2.47
Openness	Artistic Interests	Liberalism	2.62	3.06*
Openness	Liberalism	Imagination	1.41	2.97*
Openness	Liberalism	Emotionality	-0.23	1.53
Openness	Liberalism	Adventurousness	3.90*	0.96
Openness	Liberalism	Intellect	-0.77	-1.00
Openness	Intellect	Imagination	2.30	4.23*
Openness	Intellect	Emotionality	0.49	2.59
Openness	Intellect	Adventurousness	5.04*	2.09
Agreeableness	Sympathy	Trust	10.22*	6.46*
Agreeableness	Sympathy	Morality	4.88*	3.55*
Agreeableness	Sympathy	Altruism	3.60*	3.80*
Agreeableness	Sympathy	Cooperation	6.91*	4.06*
Agreeableness	Sympathy	Modesty	7.74*	4.92*
Agreeableness	Altruism	Trust	8.12*	4.15*
Agreeableness	Altruism	Morality	2.28	0.82
Agreeableness	Altruism	Cooperation	4.29*	1.47
Agreeableness	Altruism	Modesty	4.89*	2.25

Note: *significant at respective critical α (.004 for Openness and .006 for Agreeableness)

Appendix D.1: Supplementary Material for Chapter 6

Additional Analyses Hypothesis Three

Post-hoc comparisons were run with Bonferroni adjustments, critical α = .002. Significant differences across political self-identification categories between countries were found. For Conservative respondents, there was no significant difference between Australians and the British (p = .012, d = 0.25). However, there were significant differences between Americans, and Australians (p < .001, d = 0.77), and the British (p < .001, d = 0.55), such that American Conservatives, believed less in environmental phenomena than their Australian and British counterparts. For Liberal respondents there was no significant difference between Australians and Americans (p = .076, d = 0.12), but there were significant differences between the British, and Americans (p < .001, d = 0.32), and Australians (p < .001, d = 0.22), such that British Liberals, believed less in environmental phenomena than their Australian and American counterparts. Independent respondents showed no significant differences between the British, and Australians (p = .067, d = 0.23), and Americans (p = .086, d = 0.16). There was a significant difference between Australians and Americans (p < .001, d = 0.40), with Australian Independents believing more than their American counterparts. Lastly, for Other respondents there were no significant differences between Americans, and Australians (p = .030, d = 0.27), and the British (p = .039, d = 0.19), but there was a significant difference between Australians and the British (p < .001, d = 0.47), with Australian Others demonstrating higher levels of belief, than their British counterparts.

Similarly, there were significant differences across all countries between political self-identification categories. Within Australia it was found that Conservatives were significantly less likely to believe in environmental phenomena than Liberals (p < .001, d = 0.49), Others (p < .001, d = 0.45), and Independents (p = .002, d = 0.25). There were no

significant differences between Liberals and Independents (p = .009, d = 0.22), and Others (p = .752, d = 0.03), and between Independents and Others (p = .032, d = 0.19). Within the UK it was found that Conservatives were significantly less likely to believe in environmental phenomena than Liberals (p < .001, d = 0.52), and that Liberals were significantly more likely to believe than Others (p < .001, d = 0.31). All other comparisons were not significant, p = .003 to .465, d = 0.06 to 0.25. Lastly, within the USA it was found that Conservatives were significantly less likely to believe in environmental phenomena than Liberals (p < .001, d = 1.28), Independents (p < .001, d = 0.57), and Others (p < .001, d = 0.87). Furthermore, Liberals were significantly more likely to believe than Independents (p < .001, d = 0.68). There was no significant difference between Liberals and Others (p = .003, d = 0.39) or Independents and Others (p = .004, d = 0.29).

Additional Analyses Exploratory Analysis

Post-hoc comparisons were run with Bonferroni adjustments, critical α = .002. It was found that across all political self-identification categories there were significant differences between countries. For Conservative respondents, significant differences existed between Americans and the British (p < .001, d = 0.37), and Australians (p < .001, d = 0.51), but there was no significant difference between the British and Australians (p = .110, d = 0.13). With American Conservatives believing that the public should help less than their British and Australian counterparts. For Liberal respondents, this significant difference existed between Americans and the British (p < .001, d = 0.22), but there were no significant differences between Australians and the British (p = .011, d = 0.14), and Americans and Australians (p = .216, d = 0.07). American Liberals believed that the public should help more than their British counterparts. For Independent respondents, this significant difference existed between Americans and Australians (p < .001, d = 0.34), but there were no significant differences between the British and Australians (p = .028, d = 0.27), and Americans and the British (p =

.340, d = 0.10). With Australian Independents believing that the public should help more than their American counterparts. Lastly, for Other respondents, this significant difference existed between Australians and the British (p < .001, d = 0.35), but there were no significant differences between Americans, and Australians (p = .005, d = 0.30), and the British (p = .809, d = 0.02). With Australian Others believing that the public should help more than their British counterparts.

It was found that across all countries there were significant differences between political self-identification categories. Within Australia it was found that Conservatives were significantly less likely to believe that the public should help the natural environment, compared to Liberals (p < .001, d = 0.49), Independents (p = .001, d = 0.32), and Others (p < .001, d = 0.57). There were no significant differences between Liberals and Independents (p = .086, d = 0.14), and Others (p = .204, d = 0.10), and no significant difference between Others and Independents (p = .009, d = 0.23). Within the UK it was found that Conservatives were significantly less likely to believe that the public should help the natural environment, compared to Liberals (p < .001, d = 0.48) and Others (p < .001, d = 0.32). But there was no significant difference between Conservatives and Independents (p = .044, d = 0.19). There were also no significant differences between Liberals, and Independents (p = .003, d = 0.29), and Others (p = .040, d = 0.13). Lastly, there was no significant difference between Independents and Others (p = .131, d = 0.15). Within the USA it was found that Conservatives were significantly less likely to believe that the public should help the natural environment, compared to Liberals (p < .001, d = 1.08), Independents (p < .001, d = 0.43), and Others (p < .001, d = 0.66). Furthermore, it was found that Liberals believed that the public should help more than Independents (p < .001, d = 0.57). There was no significant difference between Liberals and Others (p = .004, d = 0.28) and Independents and Others (p = .008, d = 0.24).

Appendix E.1: Question Wording

Climate Change

You may have heard about the idea that the world's temperature may have been *changing* over the past 100 years, a phenomenon sometimes called *'climate change*'. What is your personal opinion regarding whether or not this has been happening?

Global Warming

You may have heard about the idea that the world's temperature may have been *going up* over the past 100 years, a phenomenon sometimes called '*global warming*'. What is your personal opinion regarding whether or not this has been happening?

Responses as presented:

Definitely HAS NOT BEEN happening

Probably HAS NOT BEEN happening

Unsure, but leaning toward it HAS NOT BEEN happening

Not sure either way

Unsure, but leaning toward it HAS BEEN happening

Probably HAS BEEN happening

Definitely HAS BEEN happening